The Odisha livestock sector strategy

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Abbreviations/acronyms

ADRI	Animal Disease Research Institute
AI	Artificial insemination
AVAS	Additional Veterinary Assistant Surgeon
BAU	Business as usual
BBR & BM	Bovine Breeding Research & Bull Mother
BQ	Black quarter
BYP	Backyard poultry
CDVO	Chief District Veterinary Officer
CIRAD	Centre de coopération internationale en recherche agronomique pour le développement
CPR	Common property resource
CVSc & AH	College of Veterinary Science and Animal Husbandry
DAH & VS	Directorate of Animal Husbandry and Veterinary Services
DOC	Day-old chick
ET	Enterotoxaemia
FAO	Food and Agriculture Organization of the United Nations
FARD	Fisheries and Animal Resources Development
FMD	Foot-and-mouth disease
FPO	Farmer producer organization
FSSAI	Food Safety and Standards Authority of India
GDP	Gross domestic product
GOI	Government of India
GSDP	Gross state domestic product
HORECA	Hotel/restaurant/cafeteria
HS	Haemorrhagic septicaemia
IAS	Indian Administrative Service
IBR	Infectious bovine rhinotracheitis
ICAR	Indian Council of Agricultural Research
ICAR-CIWA	ICAR-Central Institute for Women In Agriculture
ICARDA	International Center for Agricultural Research in the Dry Areas
ICAR-DPR	ICAR-Directorate of Poultry Research
ICT	Information communication technology
ILRI	International Livestock Research Institute
IRR	Internal rate of return
KVK	Krishi Vigyan Kendra
LIT	Low-input technology
LMP	Livestock master plan

LSA	Livestock sector analysis
LSS	Livestock sector strategy
LVC	Livestock value chain
MPCS	Milk producer cooperative society
MT	Metric tonnes
MVSU	Mobile veterinary service unit
NBAGR	National Bureau of Animal Genetic Resources
NDDB	National Dairy Development Board
NPV	Net present value
OLRDS	Odisha Livestock Resources Development Society
OMFED	Orissa State Cooperative Milk Producers' Federation Limited
OSD	Officer on Special Duty
OUAT	Odisha University of Agriculture and Technology
PPP	Public-private partnership
PPR	Peste des petits ruminants
TB	Tuberculosis
TMR	Total mixed ration
VOTI	Veterinary Officers Training Institute
WI	With investment
WSHG	Women's self-help group

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1 Introduction

The State of Odisha has developed several policy measures to enhance livestock productivity and stimulate livestock-mediated poverty reduction. It formulated its first comprehensive agricultural policy, which included animal husbandry, in 1996. In 2002, Odisha became the second of India's states to formulate a separate livestock policy. That policy aimed to position the livestock sector as an engine for socio-economic development among the rural poor, focusing on increasing household incomes, generating rural employment and improving quality of life. In 2020, the Government of Odisha launched the agricultural policy 'SAMRUDHI' (Government of Odisha 2020). Among other functions, SAMRUDHI makes provision for supporting individual farmers and women's self-help groups (WSHGs) in egg and poultry meat production. The Odisha livestock sector analysis report (ILRI 2022) details previous and ongoing efforts by the government to enhance the performance of the livestock sector in Odisha. These efforts have taken the form of policies, institutions and investments to support the improvement of animal breeds and enhance farmers' access to extension and animal health services, and interventions to address a key challenge to production imposed by the scarcity of livestock feed.

Improved livestock sector growth has coincided with major shifts in agricultural and livestock policy in Odisha. The share contributed by animal production to the state's overall agricultural gross domestic product (GDP) increased from 12.9% in 2013–14 to 23% in 2020–21 (Government of Odisha 2021a). A report by the Directorate of Economics and Statistics (Government of Odisha 2021a) indicated that the livestock sector's share in the state's gross value added at a constant basic price rose from 2.45% in 2011–12 to 3.91% in 2019–20. The average growth in the livestock sector stood at 17% at the current price in the stated years.

1.1 The livestock sector analysis

The development of the Odisha livestock master plan (LMP) has included a livestock sector analysis (LSA) (Bahta et al, 2022a) that evaluated the current (2020–21) and future (to 2035–36) contribution of priority livestock commodities under existing policy and value chain opportunities and constraints, that is, the 'business-as-usual' (BAU) scenario with the assumption of maintaining the current rate of investment or no additional investments.

The LSA uses data for 2020 and 2021 to characterize and assess the contribution of livestock to people's livelihoods and economy in the State of Odisha. The analysis includes extrapolation of potential future growth if current practices persist, and assesses potential impacts on gender equity. The gender analysis drew lessons from the literature, relying on published and grey literature, government surveys, stakeholder meetings and key informant interviews, which were conducted virtually in adherence with COVID-19 precautions. The LSA forms an integral part of the LMP, showing potential developments if alternative investments and policy changes were to be made. Ultimately, this information will help gauge the level of investments required in the livestock sector and improve livestock contributions to achieving state development goals.

The recent data show that the main livestock being reared in the state include cattle (99 lakh), small ruminants (sheep and goats, 12 lakh and 64 lakh, respectively) and poultry (309 lakh). It is worth noting that cattle and

commercial poultry are primarily owned by men, whereas women have more control over goats and backyard poultry (BYP). BYP, part of the landless system, are classified by breed type and level of intensification. Farmers, especially women, rearing a few (1–5) desi birds or fewer than 20 low-input improved-technology (LIT) birds under an extensive system are classified as BYP farming systems.

The LSA identified livestock production systems in Odisha that could broadly be clustered into three livestock production zones: coastal plain, hilly and mountain, and northwest. In addition, commercial/specialized livestock production systems exist across the three zones, separate from village livestock production systems. These systems include urban and peri-urban dairy and layer and broiler poultry systems.

Each production zone is distinct. The coastal plain zone is characterized by high human population density, with 655 people/km^2 compared to 216 people/km^2 in the northwest zone and 163 people/km^2 in the hilly and mountain zone. Of the 99 lakh cattle currently being reared in Odisha, 39% are found in the coastal plain zone, 26.3% in the hilly and mountain zone and 34.4% in the northwest zone. Improved cattle dominate in the coastal plain production zone, followed by goats and commercial poultry. Conversely, small ruminants and poultry play an essential role and dominate in the northwest and hilly and mountain zones. Stall feeding is the dominant feeding practice in the coastal plain zone, with both grazing and stall feeding occurring in the northwest zone and grazing alone in the hilly and mountain zone. Commercial feed is used more commonly in the coastal plain zone than in the other two production zones. Also, the coastal plain zone has relatively better market infrastructure, and farmers have better access to markets than in the northwest and hilly and mountain zones. On the other hand, the northwest and hilly and mountain production zones have a relatively large area of forest and grazing lands that can better sustain goat and poultry production.

Despite the growth that has been witnessed in the livestock sector, challenges and constraints persist that hinder performance. Some of the significant challenges and constraints identified include:

- A lack of feed and a lack of knowledge of balanced feeding among farmers. The current milk production level shows that dairy animals' genetic potential for milk production is not fully exploited. This is likely due to a shortage of feed resources and current feeding practices. The lack of feed resources is attributed to insufficient land and water scarcity, limiting the production of cultivated feeds. In addition, technical support services for fodder cultivation and storage are lacking and there is inadequate fodder planting material (seeds/cuttings/splits) and no fodder markets. Relief programs that compensate farmers for crop damage resulting from natural calamities or wild animals is not covered under the crop insurance , which discourages farmers from undertaking fodder cultivation in Odisha.
- The prevalence of economically important diseases, including foot and mouth disease (FMD), mastitis, brucellosis, haemorrhagic septicaemia (HS), black quarter (BQ), theileriosis and infectious bovine rhinotracheitis (IBR), and zoonoses such as brucellosis, tuberculosis (TB) and contagious ecthyma. This situation is brought about by inadequate local services and too few veterinary institutions, coupled with a lack of access to animal health services, especially for female farmers who rear goats and BYP and farmers in the hilly and mountain production zone.
- The low productivity of local breeds coupled with the unavailability of, or lack of access to, breeding services. Although consistent efforts have increased the proportion of the cattle population breed using artificial insemination (AI), AI services cover only 22% of Odisha State. In addition, little effort has been made to upgrade goat, sheep and pig breeds.
- A lack of access to markets due to limited infrastructure, including modern abattoirs, processing plants and effluent treatment units for the utilization of blood and bones, and as a result of differential access to market information, the absence of organized goat producers' groups and a lack of regulation in some markets.
- A lack of access to support services (health, extension and training, and credit) for women despite their dominance in small ruminant and BYP production.

These challenges and constraints vary across production zones, LVCs and species, and require differential approaches in terms of interventions. For instance, the frequent occurrence of cyclones is a major challenge for livestock production in the coastal plain zone; in contrast, floods and droughts present greater challenges in the northwest and hilly and mountain zones. Likewise, while FMD is a major challenge in dairy production in the coastal plain zone, it is anthrax that presents a challenge in the hilly and mountain zone.

Demand and supply projections for Odisha over the next 15 years, that is, to 2035–36, indicate that the production of livestock commodities will grow more slowly than demand. The projections were simulated for the BAU scenario in which demand and supply trends follow historical patterns, and interventions or market responses that could significantly alter production or consumption are not considered.

The projections showed that, in 2035–36 under the BAU scenario, the population of all livestock species except chickens would be lower than the current population. Although total cattle numbers are expected to decline, the population of crossbreed cattle is projected to increase. Most products show a marginal production increase between 2020–21 and 2035–36, except chicken meat and eggs, which show a significant increase. Despite this, the 15-year production and consumption projections under BAU suggest production will grow more slowly than potential consumption for all priority livestock commodities. In particular, for Odisha State:

- Consumption of milk and milk products is projected to grow by 325% from about 160 crore litres in 2020–21 to 680 crore litres in 2035-36 in the absence of constraints due to availability or increased prices. In contrast, milk production is projected to grow by 32% from 201 crore litres in 2020–21 to 265 crore litres in 2035-36. Production is thus expected to cover only about 39% of potential consumption in 2035-36.
- The consumption of goat meat and mutton is projected to increase by 70% and 378%, respectively. On the other hand, goat meat and mutton production is projected to decrease by about 2% and 10%, respectively. Thus, in 2035-36, goat meat and mutton production are expected to cover only 17% and 3%, respectively, of projected potential consumption.
- Although the production of eggs is projected to increase by 294% from 217 crore eggs in 2017-18 to 855 crore eggs in 2032-33, consumption of eggs is projected to grow by 622% from 231 crore eggs in 2020-21 to 1,668 crore eggs in 2035/36, leading to local production covering 51% of projected potential consumption.
- The total consumption of chicken meat in the state is projected to reach 41.3 crore metric tonnes (MT) in 2035-36, an increase of about 88% from 2020-21. Although domestic production is projected to increase by 136%, the projected total quantity of chicken meat produced in 2035-36, 24.4 crore MT, is expected to meet only about 59% of the total projected consumption.

In practice, a balance must exist between production, consumption and net trade into or out of a region, a balance that will be affected by price changes, costs and other factors. Thus, the differences between projected production and projected consumption discussed above primarily highlight the potential for additional consumption if production can be increased.

1.2 A livestock sector strategy for Odisha

The development of a livestock sector strategy (LSS), that is, a series of foresight analyses to explore alternative paths forward in terms of sector policies and investments (e.g., in technology), derives from the information in the LSA. This component of the work includes the development of scenarios and policy options to analyse impacts, benefits, costs and trade-offs associated with jointly defined objectives[1] or additional investments. The LSS helps identify priorities for investment in livestock at the state level.

1. Refer to Odisha livestock sector analysis (LSA) for more details on the development objectives.

Despite the challenges around achieving sufficient growth in domestic production to meet projected future consumption, livestock in Odisha hold much potential as a pathway for meeting development objectives, including poverty reduction, gender equality and women's empowerment. The projected rise in demand for livestock products will offer increased market opportunities to local producers. However, while the livestock sector's contribution to the gross state domestic product (GSDP) in Odisha has increased, its share of the total agriculture budget has been declining. For example, the livestock sector's share of the total agriculture budget in 2013–14 was 2.8% but had fallen to 1.8% in 2019–20. A major challenge is that the budget allocated to the livestock sector has not been coupled to the evidence of livestock's contributions to GSDP and, as such, it does not constitute a commensurate fraction of the whole state agricultural budget (ILRI 2022).

The LSS employs a livestock sector model for the Odisha context. This model provides a quantitative analysis of the technical performance of the sector and the potential economic contributions of alternative intervention options to households, value chains, the livestock subsector, the agricultural sector and the national economy. Quantitative tools from the livestock sector investment and policy toolkit were used in the analysis, which was based on data obtained from field surveys, published literature and expert opinion and evaluated using consistency tests. For the gender analysis, literature reviews and consultations with experts were undertaken along with key informant interviews with stakeholders involved in key livestock value chains (LVCs).

This report is organized as follows: section 2 briefly discusses livestock improvement strategies; sections 3–5 consider improvement intervention targets and impacts for the dairy cattle, small ruminant and poultry sectors, respectively; and, finally, section 6 presents conclusions and recommendations.

2 Livestock sector improvement strategies

Livestock play a vital role in the economic development of Odisha and in reducing income inequalities because livestock ownership is more equitable than land ownership. About 85% of the livestock population is owned by landless individuals and marginal and small landholders, providing 30–40% of their annual income. Birthal and Negi (2012) defined the livestock sector as a form of capital that can be reproduced or multiplied (sometimes quickly) to generate wealth. In recent decades the dairy sector has emerged as an important source of rural employment and income (Jha 2007; Jaiswal et al. 2018). The contribution of this sector to GSDP has increased from 2.45% in 2011–12 to 3.91% in 2019–20. However, the dairy sector is confronted by several challenges[2], including inadequate supplies of quality feed, the frequent occurrence of diseases, cyclones and floods, the poor availability of quality germplasm and low-level market linkages. Furthermore, socio-economic and institutional factors, such as shrinking areas of grazing land and a lack of access to institutional credit, information and modern technology for livestock management, hinder livestock keepers from achieving higher profits.

Significant gender inequalities also exist in the sector. Some of the key inequities experienced by women in LVCs are:

i) Gaps in ownership and control over animals and the income derived from them.

ii) Gaps in information, knowledge and skills related to livestock production, food safety, nutrition, biosecurity and zoonoses.

iii) Social and cultural barriers that limit their engagement and participation in LVCs.

iv) Limited access to veterinary services for the species they own, mainly goats and BYP.

v) Lack of market information and limited access to formal markets.

vi) Gaps in the skills and knowledge needed to participate in all aspects of the non-producer LVC nodes at an industry level.

Overcoming these challenges requires evolving suitable development strategies and targeting the production zones and species that have the potential to generate significant economic and social gains. Moreover, focused gender and social inclusion strategies are needed to allow marginalized communities and women to participate in and benefit from the livestock sector.

A consultation workshop was organized chaired by the director of the Directorate of Animal Husbandry and Veterinary Services (DAH & VS), Odisha, on 17 September 2021, to elicit key strategies for addressing the challenges and constraints faced by the livestock sectors (cattle, goat, sheep and poultry) in the different production zones. Senior officials from the DAH & VS, experts from Odisha University of Agriculture and

2. See the livestock sector strategy (LSA) for detailed opportunities and constraints by value chain and production systems.

Technology (OUAT), scientists from the Indian Council of Agricultural Research-Central Institute for Women in Agriculture (ICAR-CIWA), Bhubaneswar, and the ICAR-Directorate of Poultry Research (ICAR-DPR), Bhubaneswar, researchers from ILRI and staff from Samagra Governance all participated in the workshop. Separate individual meetings were also organized alongside the workshop.

This section discusses possible interventions for the different species in the three livestock production zones that have the potential to create general economic and social gains without causing significant damage to the environment and natural resources.

2.1 Cattle value chain improvement strategies

Dairy contributes the major share of total livestock value in Odisha (Singh et al. 2013). However, many resource-poor and small-scale dairy farmers derive limited benefits from emerging demand for high-value products (Gulati 2008; Kumar et al. 2011) because they have limited access to markets (consumers). In addition, milk yields are low. Although Odisha State has made significant improvements in milk production, productivity remains low compared to the national average and neighbouring states such as Andhra Pradesh. The low productivity in the state is due to poor animal health, insufficient feed and fodder (Swain et al. 2015) and poor husbandry practices.

Table 1 summarizes potential strategies to address key challenges, which vary by production zone. These strategies include conservation of forages, improvement of feed quality, expanded veterinary services and vaccination management.

Table 1: Key strategies to address production challenges: cattle (by zone)

Management category	Production zone		
	Hilly and mountain	Northwest	Coastal plain
Feed	• Increase conservation of green fodder in the form of hay and silage • Use buffer stocks of feed during feed-scarce periods • Ensure year-round availability of concentrate feed in markets • Improve the nutritional value of underutilized residues (e.g. maize stover, ragi and others) through treatment using chemicals like urea • Allow farmers to access the periphery of forest areas for cattle grazing	• As industries dominate this zone, use corporate social responsibility funds to promote and cultivate fodder • Develop silviculture • Promote short-duration fodder crops and dual-purpose crops • Use underutilized crop residues (such as paddy straw, maize stover, groundnut haulm and green gram residue) as livestock feed	• Improve the storage mechanism for available crop residues and keep for cattle consumption during lean periods • Create awareness of the need to harvest green fodder before the cyclone season and store it at cyclone centres to feed distressed animals • Ask the Odisha State Disaster Management Authority to start a feed block manufacturing unit • Promote short duration (seasonal) green fodder, including dual-purpose crops, in rice fallow land
Breeding	• Continue to conserve and upgrade recognized breeds (i.e. Khariar and Motu) in their native environment • Train or recruit more technical staff • Ensure national and state AI programs continue	• Improve AI coverage and success rates • Study and characterize all nondescript cattle populations in collaboration with the National Bureau of Animal Genetic Resources	• Adopt the early pregnancy test method • Improve AI success rates • Facilitate conservation and upgrading of recognized breeds (i.e. Binjarpuri and Ghumsuri)

Management category	Production zone		
	Hilly and mountain	Northwest	Coastal plain
Health	• Increase availability of veterinary services • Improve the accessibility of mobile clinics and operationalize existing subdivision-level diagnostic facilities • Make available year-round schedules/events for deworming and vaccination (haemorrhagic septicaemia, black quarter, foot and mouth disease and brucellosis) activities	• Increase availability of veterinary services • Improve the accessibility of mobile clinics and operationalize existing subdivision-level diagnostic facilities • Improve management at all farming levels • Identify diseases arising from industrial pollution • Control worm infections in calves and adult cattle	• Improve the accessibility of mobile clinics • Advance the disease surveillance and reporting system • Organize health camps immediately after floods or cyclones • Deworm and vaccinate all cattle immediately before rainy season • Ensure proper drainage for relieving floods • Avoid feeding rotten paddy straw during the rainy season • Train women in good husbandry practices since they are primary caregivers

2.2 Small ruminant value chain improvement strategies

Small ruminant farming contributes to the livelihoods of over 30% of Odisha's rural population. Most small ruminants are owned by women, the landless and marginal farmers, including nomadic and ethnic tribal groups. Small ruminants can play a crucial role in reducing poverty within these populations (LAC 2020; Mohanty et al. 2020). Goats and sheep are regarded as 'the poor man's cow' (MacHugh and Bradley 2001) and are most important in dryland or upland farming. The density of the small ruminant population positively correlates with the percentage of forest cover and the proportion of scheduled tribes (IFAD 2018). Forage available in the periphery of forest areas is the major source of feed for goats. Hegde and Deo (2017) reported that the majority of goat keepers graze their goats in village forests and provide tree foliage as supplementary feed wherever available. Goat meat production can be enhanced by improving access to forages available in the periphery of forest areas, which cover 30% of the state's land. Demand for goat meat has increased over the years due to urbanization and increasing household income.

However, the sector faces various problems (Bahta et al. 2022a), including a lack of health care facilities, insufficient feed, high mortality and limited formal market access. A consolidated effort needs to be made to improve goat meat production by addressing the constraints described in the Odisha LSA (ILRI 2022).

2.3 Goat value chain improvement strategies

There is considerable scope for developing goat production and marketing. Goat meat productivity can be increased by decreasing mortality and improving farmers' goat management skills through intensive extension programs. The key potential strategies to address the goat value chain's foremost challenges include improvements in feeding, breeding and health (Table 2).

Table 2: Key strategies to address production challenges: goats (by zone)

Management category	Production zone		
	Hilly and mountain	Northwest	Coastal plain
Feed and fodder	• Develop a common approach for establishing a green belt in the fringe of the forest, on contour bunds and the embankments of the grazing area • Plant the periphery of forest areas with multipurpose fodder tree species • Plant fodder trees on roadsides during afforestation drives	• Develop an action plan for the utilization of pastureland for silvipasture programs by engaging women's self-help groups • Introduce short-duration, low-water consumption fodder species after harvest of kharif crops	• Introduce fodder tree plantations along the boundary lines of backyards • Establish small hydroponic units for daily green fodder production • Ask revenue authorities to release gochar land (cattle grazing field) under illegal occupation so that cattle owners can graze their animals
Breeding/ genetic	• Recruit more technical staff in this zone • All unrecognized goat species should be distinguished scientifically to assert breed types and upgrade	• Upgrade the two recognized breeds (i.e. Ganjam and Black Bengal) through community-based selection • Supply an improved breed (i.e. Sirohi and Boer) to improve the body weight of the local breed	• Upgrade the two recognized breeds (i.e. Ganjam and Black Bengal) through community-based selection • Crossbreed Ganjam goats with other improved breeds in India (i.e. Sirohi and Jamunapari)
	• Introduce and promote goat AI in a pilot phase in a potential cluster • Provide quality bucks for breeding purposes		
Health	• Pay special attention to nomadic goat farmers to ensure they understand the importance of vaccination and deworming • Increase the 24/7 coverage of goat animal health and management services via the use of community-based animal health workers, especially women (Prani Mitras)	• Conduct a massive campaign on the importance of deworming and vaccination • Ensure mobile veterinary units give priority to goat vaccination	• Conduct a massive campaign on the importance of deworming and vaccination • Ensure mobile veterinary units give priority to goat vaccination
	• Develop a basic training program to engage young, educated and interested female and male candidates, who, in turn, can act as guides and mentors on animal welfare to others in a self-sustaining manner • Develop a deworming and vaccination for routine preventive health care of goats		

2.4 Sheep value chain improvement strategies

Sheep production is an important source of income for marginalized people in Odisha, including tribal regions, and can reduce the prevalence of poverty. However, sheep development in the state has been neglected at the policy level. Some interventions to improve mutton production in the state are listed in Table 3.

Table 3: Key strategies to address production challenges: sheep (by zone)

Management category	Production zone		
	Hilly and mountain	Northwest	Coastal plain
Feed and fodder	• Introduce a common approach for establishing green belt fringes on the edge of forest areas	• Formulate and approve an action plan for utilizing pastureland for a silvipasture program	• Introduce fodder tree plantations along the boundary lines of backyards • Introduce short-duration fodder species during the rabi season
	• Improve grazing areas/wasteland on the routes of nomadic flock owners with fodder such as stylo, a forage grass		
Animal health	• Initiate a massive campaign to raise awareness of the importance of deworming and vaccination • Earmark a fixed date/week for routine deworming of sheep • Ensure mobile veterinary units prioritize sheep vaccination		
Breeding	• Upgrade the two registered breeds (i.e. Balangiri and Koraput) • Based on demand from neighbouring states (i.e. Andhra Pradesh, Telangana, and Chhattisgarh), rear the sheep breed of choice in Odisha for export	• Introduce ram exchange program	• Upgrade the two registered breeds (i.e. Ganjam and Kendrapada)
	• Encourage the establishment of male lamb rearing centres in suitable areas		

2.4.1 Poultry value chain improvement strategies

Odisha has experienced significant increases in egg and poultry meat production over the last few years. However, the per-capita availability of eggs is still very low (54 eggs/person per year) compared with the national average (79 eggs/person per year) and with neighbouring states like Andhra Pradesh (420 eggs/person per year). Systematic, concerted efforts are required to reach the national average. Improvement strategies for the poultry value chain for the different types of bird (desi, broilers and layers) are discussed in Table 4.

Table 4: Key strategies to address production challenges: backyard poultry, commercial layers and broilers (all zones)

Management category	All production zones Backyard poultry
Feed	• Create awareness of balanced feeding (available feed resources and the number of birds in the locality) • Promote use of broken rice/other grains/locally available feed resources as feed supplements
Breeding	• Promote LIT BYP, with clear information about their performance and availability of chicks, and the dissemination of new management practices that can be adopted • Promote low-cost small hatcheries at the community level in backyard-intensive areas; this can be linked to WSHGs/rural unemployed youth
Health	• Develop and implement area-specific deworming and vaccination calendars through community-based animal health workers (Prani Mitras) or public-private partnerships • Improve poultry disease surveillance and reporting systems starting at the grassroots level • Commercial layer production
Feed	• Establish robust feed quality control, regulatory systems and laboratories

Management category	All production zones Backyard poultry
Breed	• Increase the availability of affordable parent stocks and day-old chicks
Health	• Establish robust disease surveillance, diagnostic, prophylactic and reporting systems
	• Commercial broiler production
Feed	• Use broiler integrators to support farms with feed (starter, grower and finisher) and supplements • Establish robust feed quality control, regulatory systems and laboratories
Breed	• Promote integrators while strengthening input and product quality and price regulation and control • Use tested breeds of broiler chicken
Health	• Use broiler integrators to support farms with timely delivery of vaccines and vitamins • Improve capacities of local veterinarians • Create mass awareness among poultry farmers of high-threat emerging diseases • Encourage regular vaccination and proper management, maintenance of high-grade biosecurity, provision of appropriate vaccines as required and timely identification of exposure to diseases

2.5 Postproduction improvement strategies

Livestock production constitutes a very important component of the agricultural economy. Its contribution goes beyond food production to purposes such as skins, fibre, fertilizer, fuel and capital accumulation. Without proper planning in postproduction management, it will be difficult for farmers to profit from the sector. To improve postproduction management, a series of interventions have been identified and are discussed below.

2.6 Postproduction in dairy sector

To bring efficiency in the milk market and improve smallholders' access to the market, cooperatives were launched in the dairy sector and have expanded considerably since the introduction of the Operation Flood Program in 1970 under the National Dairy Development Board (NDDB). However, despite the potential, milk procurement through cooperatives remains low. The dairy cooperatives have failed to bring smallholder producers within their organizations and to link them to markets effectively. This may be attributed to the inadequacy of the road network and distances between production and consumption locations. Less than 10% of milk produced is procured through formal channels. Such low rates of formal milk procurement increase the presence of intermediaries in the milk supply chain. In the process, the intermediaries essentially pool the available surplus from farmers, paying little attention to the quality and development of the smallholder dairy sector.

Further, due to the lack of proper mechanisms for checking milk quality, milk sold in the informal market is often adulterated with water and sold at lower prices per unit than products sold in the formal sector. With low incomes and living standards, many consumers are highly price sensitive with food items. Despite its compromised quality, they tend to purchase milk from informal market channels, which are easily available. Traditional milk markets are projected to retain their importance despite the growth of a modern milk supply chain.

Table 5 briefly presents postproduction improvement strategies for the dairy sector in the three production zones. At the milk collection level, varying strategies were identified for the different zones. In the coastal plain zone, milk price support was proposed, while the establishment of more milk collection centres was proposed for the northwest zone. In the hilly and mountain zone more formal cooperative societies were proposed. Improvement strategies were proposed across the production zones for the formal and informal milk processing sectors.

Table 5: Postproduction improvement strategies for the dairy sector in Odisha

Management category	Production zone		
	Hilly and mountain	Northwest	Coastal plain
Milk collection	• Increase the number of formal milk producer cooperative societies • Improve milk transportation from collection points through the use of refrigerated/ insulated tankers	Establish more milk collection centres with support from the district mineral fund	Offer milk price support in formal cooperatives
Milk processing	• Establish more processing plants at strategic locations with an inbuilt mandate for future expansion • Encourage private sector entities to establish dairy processing plants in different locations • Train women in milk processing (i.e. the production of ghee, paneer, rabidi, ice cream and cottage cheese) to support dairy farmers in rural areas who have problems selling their fresh milk • Introduce mobile milk processing units at the panchayat level to process surplus milk at farmers' doorsteps		
Sales and retailing	• Introduce milk or milk products to schools' mid-day meal programs and distribute them among pregnant women • Focus on food safety and hygienic handling during the selling of milk and milk products • Open milk parlours in village markets		
Complementary measures	• Encourage district authorities to recognize and acknowledge farmers adopting good management practices on dairy farms at annual public functions (e.g. Republic Day celebrations) • Invite WSHGs to participate in milk marketing or give them responsibility for operating milk parlours		

2.7 Postproduction in small Ruminant sector

Goat farming constitutes the means of livelihood for more than 25% of Odisha's rural population. Goats are reared predominately by women, the landless and marginal farmers, and to a lesser extent by small-scale farmers (Kumar et al. 2010). Barriers to improving the earnings of small-scale and landless goat farmers include high animal mortality resulting from disease, inbreeding and lack of an organized marketing structure. However, there is a huge opportunity with the gradual increase in urban and periurban domestic demand for processed meat products. Organized development of processed meat production is needed to realize full benefits from the goat meat subsector and contribute to sustainable meat production. Table 6 briefly presents postproduction improvement strategies for the goat sector.

Table 6: Postproduction improvement strategies for the goat sector in Odisha

Management category	All production zones
Collection system	• Create formal goat markets at block level offering female-friendly infrastructure such as separate bathrooms, childcare rooms, etc. • Give integration companies facilities in which to conduct their business • Form a single marketing agency to check and control the collusive activity of market traders • Provide weighing scales and train female goat producers to sell goats by body weight rather than visual appearance • Decide the price of goats based on their body weight • Form a goat producer association/farmer producer organization to enhance the bargaining power of goat producers • Motivate WSHGs

Management category	All production zones
Processing	• Ensure government clearance/subsidy focuses on encouraging investment in modern abattoirs and the availability of mutton (processed) in supermarkets • Consider building slaughter points at village markets, for hygienic slaughter and sale of meat
Sales/ retailing	• Promote meat cut/product packs and ready-to-eat meat and sausages/shawarma • Establish a goat meat cold chain in urban and village areas • Manage wastewater and offal • Develop formal goat meat parlours at panchayat/block level • Encourage WSHGs to participate in this chain
Comple-mentary measures	• Develop short-term training programs on goat entrepreneurship development and scientific goat-rearing practices aimed at women and youth • Promote goat meat at trade shows • Increase coverage and availability of goat health and management-related services using community-based female animal health workers (Prani Mitras) to reach out to female producers

Table 7 presents proposed postproduction strategies for enhancing the performance of the sheep value chain. At the collection level, the proposed strategies include horizontal coordination among producers through the formation of sheep producer associations/farmer producer organizations (FPOs) that could enhance their bargaining power and enhance access to market information among sellers. At the processing level, it was proposed that the emergence of leather industries should be promoted, while at the retailing level, restaurants and hotels in tourist areas should receive training in how to serve sheep meat. It is also proposed that specific sheep-rearing farmers be identified in all production zones. An area-specific comprehensive plan can be developed, covering training, supply of inputs and the establishment of market avenues.

Table 7: Postproduction improvement strategies for the sheep sector in Odisha

Management category	All production zones
Collection system	• Form a sheep producer association/FPO to enhance the bargaining power of sheep producers • Ensure real-time market information is available to sheep sellers; this can be done by providing information through messaging and TV • Have representatives of sheep farmers on the livestock market committee; the committee should fix the minimum retail price of sheep meat during the offseason
Processing	• Encourage leather industries to use sheep and goat skins
Sales/retailing	• Train restaurants and hotels in tourist areas in how to serve sheep meat • Promote sheep meat by opening well-furnished sheep meat stalls under public-private partnerships
Complementary measures	• Identify specific sheep-rearing farmers in all production zones • Develop an area-specific comprehensive plan, which covers training, supply of inputs and establishment of market avenues

2.8 Postproduction in poultry sector

The proposed postproduction strategies for chicken meat and eggs are presented in Table 8. For BYP, these include educating female farmers on opportunities for higher profitability during the festive season as a result of increased demand; adoption of good husbandry practices to reduce chick mortality; and establishment of

organized marketing of BYP eggs and meat. For commercial layers, proposed strategies include entrusting OPOLOFED (the Odisha State Poultry Products Co-operative Marketing Federation) with egg marketing in the state, capacity building on export-quality egg production and establishing a nodal agency at the DAH & VS to regulate private layer farm activities.

Table 8: Postproduction intervention strategies for chicken meat and eggs

Management category	All production zones
Backyard poultry	• Encourage female farmers to introduce enough chicks well in advance to maximize profit during the festive season • Educate and train female farmers to adopt good husbandry practices to reduce chick mortality and make sales at an appropriate time to maximize profits • Establish organized markets to sell BYP eggs and meat for efficient marketing of poultry produce • Arrange a special training program on the economics of BYP production
Layer production	• Entrust OPOLOFED with the task of egg marketing in the state • Increase capacity for eggs/meat storage facilities • Single-window disposal for the infrastructure development and project guidance • Use technology interventions to assist small farmer development • Provide education and training on export-quality egg production • Establish a nodal agency at the DAH & VS to regulate private layer farm activities
Complementary success	• Establish marketing facilities • Encourage branding, packaging and traceability of value-added products • Introduce transferring technology • Offer 'handholding' support to increase exports • Register all broiler farms with the state nodal agency

2.9 Recommendations for interventions in all LVCs to mainstream and improve gender and social inclusion

Livestock marketing and processing can serve as platforms from which to initiate equitable gender-responsive actions to ensure women and youth can increase their incomes, food security and wellbeing, and to improve intrahousehold decision-making. Extension and training activity would be cross-cutting in all three LVCs and crucial for the successful implementation recommended interventions as significant gender inequalities exist in access to technologies, technical information and knowledge. Table 9 sets out recommended activities and actions to overcome gender-related barriers to successful livestock production.

Table 9: Gender considerations and recommended activities

Gender considerations	Recommended gender-responsive activities and actions
Livestock production	
• Social and cultural barriers • Women's mobility is often much more restricted than men's, affecting their access to institutions and markets • Heavy domestic workloads can prevent women from attending animal health and production training	• Promote and support women in acquiring and owning livestock • Engage with the community and men to improve understanding of gender roles and the benefits of women's economic empowerment • Introduce labour-reducing technologies and equipment to support women's activities (e.g. machinery for chopping fodder, water supply) • Provide women's groups with training venues offering appropriate facilities (such as separate bathrooms) closer to their homes • Develop and distribute information, education and communication (IEC) materials in local language with appropriate photographs to cater to differential needs of men and women
• Animal nutrition • Lack of feed and fodder is often a key constraint for women with limited time, finance and mobility to collect, store and purchase	• Develop demonstration sites to encourage adoption of technologies for making mineral blocks and silage, formulating balanced feed, azolla cultivation, and white ant and maggot production • Introduce technologies for reducing livestock feed wastage and reducing women's workloads (e.g. improved feed troughs, forage choppers) • Revive common property resources through the participation of WSHGs (e.g. Mahatma Gandhi National Rural Employment Guarantee Act (MNREGA)) • Encourage fodder tree plantations (with the Department of Forests, Environment and Climate Change) and fodder production (moringa, jackfruit) in backyards, around houses or on bunds between fields
• Limited access to breeding services (especially for goats)	• Create awareness among women about inbreeding and its impact • Animal Husbandry Department (AHD) to provide quality breeding bucks to WSHGs/ village institutions/youth on a two-year rotation system
Livestock disease management and food safety	
• Limited access to animal health and veterinary services • Due to cultural reasons, women lack mobility, time or money to access private veterinary services	• Train Prani Mitras (female community-based animal health workers) to ensure regular vaccination and deworming of goats and BYP • Train women's groups to identify, prevent and report livestock diseases and adopt vaccinations • Support mobile animal health clinics (including female staff) for doorstep services • Include livestock good management skills in the school curriculum
• Zoonotic diseases and food safety • Women are more exposed to zoonotic diseases (like TB and brucellosis) through their close association with livestock and handling of raw animal products • Men involved in slaughtering are exposed to anthrax, brucellosis, etc.	• Train more women in 'One Health' to ensure better compliance with control strategies for zoonotic diseases • Design and support the implementation of gender-specific food hygiene training programs that address key health and food safety issues, e.g. hygienic handling of milk and meat • Train butchers on hygienic practices while slaughtering and storing meat • Build village slaughter points with wastewater and offal management (to be run by youth) • Design gender-sensitivity training for vets and extension workers so that they include both husbands and wives in any training they offer

Gender considerations	Recommended gender-responsive activities and actions
Livestock marketing and processing	
• Live animal and product marketing • Male and female livestock farmers often rely on traders who buy at the farm • Payment is based on visual examination and not on body weight	• Establish small-scale, hygienic milk collection centres close to producers • Develop female dairy entrepreneurs, link them with milk cooperatives and include them in leadership roles • Provide designated shops/spots for women to sell their produce, and provide childcare rooms and toilet facilities in livestock marketplaces (haats) • Train women on adding value to animal products and on marketing of Animal source foods (ASFs) • Promote marketing chains that allow women to participate and benefit
• Lack of market information and understanding of market dynamics • Women have reduced bargaining capacity with retailers, traders or milk collectors	• Facilitate self-help groups (through Mission Shakti)/producer groups to sell collectively or realize better prices, especially for festival sales (Eid, etc.) • Provide access to market information (e.g. via mobile phone) • Provide basic numeracy/business management training so that women sell goats and chickens by weight
• Wages, jobs and entrepreneurship • Self-employment in the livestock sector can be a feasible livelihood strategy for women	• Sensitize livestock industry (dairies, poultry/goat meat processors, etc.) to the need to recruit female workers and create awareness of the benefits of employing both men and women • Train women in entrepreneurial and technical skills for product development and value addition (e.g. ghee, paneer, sweets) • Consider having lower credit requirements (e.g. smaller down payments) for women and youth, as they often lack cash

3 Dairy improvement intervention targets and impacts

3.1 Investment context

Cow-based dairy is a prominent source of income and employment for rural, urban and periurban communities in Odisha. It also contributes a great deal to Odisha's GSDP, making up 81% of the livestock GSDP and 9.1% of the agricultural GSDP (Government of Odisha 2021b). About 37 lakh households in Odisha own cattle and so derive livelihoods from the dairy sector (Government of India 2020). Many more households make their living from postfarm dairy activities. Dairy production from indigenous and crossbreed cattle extends across all state areas. The dairy improvement interventions proposed in this document will, therefore, target the whole state. The major interventions cover improvements in genetics and feeding, health and extension service delivery, marketing and processing of milk and milk products, and research. This LSS document will test the impacts of dairy improvement interventions under two foresight scenarios: BAU and 'with intervention' (WI).

- The BAU scenario represents the base-case scenario where there will be no additional investment or any change in the types of investment. This scenario analysis shows the impacts of continuing the current type and level of investment and recurrent spending on milk production and contribution to GSDP throughout the LSS analysis period of 15 years.
- The WI scenario represents the scenario where there will be additional investments in dairy improvement. This scenario analysis shows the impacts of the additional investments on milk production and productivity, and contribution to GSDP. This scenario aims to meet the future milk consumption level of the state.

3.2 Interventions and targets at state and production zone levels

All the dairy improvement interventions will be implemented in all of the livestock production zones (hilly and mountain, northwest and coastal plain).

3.2.1 Genetic improvement interventions

According to Odisha State's 2020–21 annual report (Government of Odisha 2021b), the Cuttack semen production station was the only frozen semen production facility in the state, with an annual capacity of 10 lakh straws. In 2020–21, the station produced about 5,36,365 semen doses, with about 72% of the total semen doses coming from elite exotic animals and 28% from elite indigenous animals. The total number of inseminations performed in Odisha during 2020–21 was about 12.24 lakh (Table 10), of which about 6.67 lakh inseminations were conducted under the national insemination program. In total, 6.82 lakh animals were inseminated, giving a rate of insemination repeats of 1.79. In the same year, the number of calves born was about 4.13 lakh.

Table 10: Selected reproductive parameters from Odisha State's annual report for 2020–21

Parameter	Value in 2021 report
Number of inseminations	12,24,000
Number of inseminated animals	6,82,000
Number of inseminations per animal	1.793
Number of calves born in the same year	4,13,000
Total inseminations over total births	3
Number of sexed semen doses used	3,737
Sexed semen as a percentage of total inseminations	0.3
Percentage of semen produced in Cuttack using elite indigenous cattle	28
Percentage of semen produced in Cuttack using elite exotic cattle	72

Source: Government of Odisha 2021b

The national Ministry of Fisheries, Animal Husbandry and Dairying, in its annual report for 2020–21, stated that 22% of cattle in Odisha received AI (Ministry of Fisheries, AHD 2021). According to the national AI program guideline (Ministry of Fisheries, AHD 2020), national AI coverage is only about 30%. The remaining 70% of the animals are being bred by scrap bulls and bulls of unknown genetic merit, or cows are not being bred.

Both the 2015 Odisha Bovine Breeding Policy (Government of Odisha 2015) and the national AI program guideline (Ministry of Fisheries, AHD 2020) set a target of achieving 70% AI coverage in the state and the country. However, the guideline noted that states and districts with AI coverage below 50% might not achieve the 70% AI coverage target in the coming five years. Based on a consultation with a team of experts (see Annexe, Tables 45–50), the target therefore is to increase AI coverage in Odisha from the current 22% to 30% in the coming five years (2025–26) and to 40% by 2031–32 and 60% by 2035–36.

The other important aspect of AI is the use of sexed semen or sex fixers to increase the number of female births. In 2020–21, about 3,373 sexed semen inseminations were performed, 0.3% of the current total inseminations (Table 11). The proportion of sexed semen inseminations is targeted to rise to 30% of total inseminations in five years and to 40% in 10 years; it will then be maintained at 40% until 2035–36 (Table 11).

Table 11: Base year (2020–21) and 5-, 10- and 15-year AI targets

Activities	Base year	Targets		
	2020–21	2025–26	2030–31	2035–36
Number of breeding adult females available for AI	–	36,71,138	37,18,375	37,89,055
AI coverage	22%	30%	40%	60%
Number of inseminations	12,24,000	27,53,3544	37,18,375	56,83,583
Expected number of births	416,160	936,1405	12,64,248	19,32,418
Number of sexed semen inseminations used	3,737	826,006	14,87,350	22,73,433
Sexed semen inseminations as a percentage of total inseminations	0.3%	30%	40%	40%

Data sources: Government of India 2021; Government of Odisha 2021b

- Odisha has one frozen semen bank, which is under the control of the Directorate of Animal Husbandry and Veterinary Services (DAH & VS). The capacity of the existing bank should be increased in the coming five years. An additional bank should be developed between 2025–26 and 2030–31 and a further bank developed between 2030–31 and 2035–36.

- The number of AI performed in 2020–21 was about 12.24 lakh. The target is to raise the number of AI services to 27.53 lakh within 5 years (2025–26), 37.18 lakh by 10 years (2030–31) and 56.83 lakh by 15 years (2035–36).

3. For future projections and calculations, the panel of experts proposes to use 2.5 repeat – the first 5 years and 2 repeats per cow for >5 year projections

4. The factor 2.5 AI repetitions per conception is used for the calculation

5. The rate observed in the base year is used to estimate the number of births in the subsequent years

- The existing semen production centre capacity will increase to 20 lakh straws/year with the improvement of the station (only the purchase of bulls and land for feed production is required). One more semen production centre with a capacity of about 15 lakh straws/year should be added in the next five years. There is an additional target to add one more sexed semen production centre with a capacity of 20 lakh straws/year between 2025–26 and 2030–31.
- In Odisha, there are 4,297 AI centres (541 veterinary dispensaries and hospitals, 2,783 livestock aid centres and 973 OMFED [Odisha State Cooperative Milk Producers Federation] AI centres), although not all are fully functional. Of the total AI centres, 3,086 are under the control of the DAH & VS, of which 60% are functional. Non-governmental organizations manage 285 AI centres. The AI centres available in Odisha should be sufficient to cater to all breeding cattle and buffalo (one AI centre covers 800 to 1,000 breeding animals). Therefore, the recommendation is not to add new AI centres but to upgrade non-functional centres and make them functional. These AI centres will cater to both cattle and buffalo. Staffing is a major issue for effective AI operation and should be addressed as one of the interventions to make the AI centres fully functional.
- There are eight cattle breeding farms in Odisha, all under the control of the DAH & VS. None of the cattle farms is currently fully functional. By 2025–26, all the existing breeding farms should be made functional and upgraded. High-grade animals should be included in the farms. One farm should be used for embryo transfer, sexed semen and molecular genetic purposes.
- There are three liquid nitrogen storage points in Odisha, all under the control of the DAH & VS. The target is to add one liquid nitrogen storage plant in the coming five years, one more between 2025–26 and 2030–31, and one more between 2030–31 and 2035–36.
- Currently, there is one bulk liquid nitrogen transportation facility. The target is to add three liquid nitrogen transportation facilities by 2025–26.
- Mechanized agriculture, which is being promoted across Odisha, reduces dependency on draught animals, thus limiting the use of bulls/ox/male buffalo bulls, facilitating an increase in the number of crossbreed cows and a decrease in the number of indigenous cattle.

3.2.2 Research and extension interventions

- Only Odisha Veterinary College conducts livestock research in the state. Over the next five years, the capacity of the college should be strengthened to enable research in all livestock sectors.
- Three regional livestock research centres will be established, one every five years. Each will require 20-40 hectares of land. There will also be technology transfer stations and high-level training centres (offering certificates and diplomas).
- An Animal Sciences and Fisheries University will be established in Odisha as per the proposal already in action.

There currently is no dairy science college in Odisha. The aim is to establish one Dairy Science College under the proposed Fisheries and Veterinary sciences university[6] to serve as a dairy excellence centre[7]. It will offer undergraduate and diploma programs as well farmer training.

- There are 31 Krishi Vigyan Kendra (KVKs) (agricultural extension centres/farm science centres) in Odisha. Only seven KVKs have animal scientists. By 2023 each KVK will have one animal scientist.
- There is one Animal Disease Research Institute (ADRI) in Odisha serving as a state-level referral diagnostic laboratory. The institute should be upgraded, and more technical staff should be recruited.

6. Digital learning https://bit.ly/3OmGQSl

7. Excellence centers are created for two purposes of research and training, to meet the industry needs. They specifically focus on market needs and consumer needs rather than conducting research for publications.

- Due emphasis will be placed on intensive research in dairy, feed and nutrition, health, extension, and marketing and processing of livestock products.
- Training centres with different capacity levels will be established at different administrative levels.
- The veterinary college will focus on high-level training to cater to graduate and undergraduate extension workers.
- Research and excellence centres will also offer certificate and diploma training.
- KVK centres will provide training to farmers, women and unemployed youth.
- Block-level training centres can offer training to farmers and other input suppliers.
- To improve the block-level extension service, one extension officer should be allocated to each block (314 blocks in total) in the coming three years.
- Private extension service providers will be promoted. By 2025–26, subdivision-level certified private extension service providers will be available, and by 2030–31, certified private extension service providers will be available at the block level.
- The public sector bodies at the different levels will be involved in providing public extension services and supporting, controlling and regulating private extension services.
- In the first two years of the development plan, the necessary acts, regulations, guidelines and manuals will be developed/improved to provide incentives for private extension service providers to grow faster. The procedures to join and stay on the service will be simplified. Control of unregistered input, advisory and marketing service providers is also critical for the survival of legally registered private extension service providers.
- The coverage of consistent, intensive dairy improvement training/exposure visits will reach 30% by 2025–26, 50% by 2030–31 and 60% by 2035–36. Farmers will receive more intensive and continuous training in cattle management (feeding and nutrition, breeding, deworming, disease control, hygienic milk collection, handling, value addition, transport, etc.).
- The telecommunication extension service should be strengthened through the introduction of information and communication technology (ICT) such as SMS/WhatsAPP for mobile clinics and AI interventions.

3.2.3 Health interventions

- There are 30 district veterinary hospitals in Odisha, which provide animal health care, AI, vaccination, feeding and fodder technology and advisory services. None of the hospitals is functioning optimally due to staff shortages. Adequate staffing at the hospitals is critical for them to be fully functional.
- There are 541 veterinary dispensaries in the state. Veterinary dispensaries work at the block level: 314 veterinary dispensaries are located at block headquarters, while the remaining 227 are found outwith block headquarters, where there are believed to be more animals. Based on the assumption that one veterinary dispensary can serve an average of 7,000 animals (both large and small ruminants), the number of veterinary dispensaries will be increased to 850 by 2026–27, 1,150 by 2031–32 and 1,500 by 2036–37.
- There are 314 mobile veterinary service units (MVSUs). MVSUs work at the block level and provide farmers with services such as treatment for sick animals, minor surgeries, AI, castration, vaccination (both routine and campaign), on-the-spot examination of samples and treatment of anoestrus and infertility, as well as raising public health awareness of zoonotic diseases, etc. During 2020–21, 2,936,468 animals were treated and castrated by MVSUs and 4,036,564 were vaccinated. The activities of MVSUs should be encouraged and strengthened by recruiting more staff.

- There are 3,239 livestock aid centres at the gram panchayat level. The aim is to increase the number of aid centres in Odisha to 4,500 by 2025–26, 5,800 by 2030–31 and 6,800 by 2035–36, with each veterinary dispensary associated with two livestock aid centres.
- Cattle are already being vaccinated against important diseases (FMD, 87% currently; brucellosis, 87% currently; HS and BQ, both 50% currently (Government of Odisha 2021b), and vaccination against anthrax will increase to 90% by 2026–27. The major intervention in this area would be to make vaccination campaigns more timely.
- Animal mortality resulting from flooding and cyclones can be decreased by improving early warning and awareness systems and establishing livestock shelters in cyclone/flood-prone districts.
- The proportion of farmers adopting the recommended rate of external and internal parasite control treatments will reach 80% in the coming 15 years.
- The capacity of the Odisha Biological Products Institute and its branches will be strengthened, re-equipped and modernized with the necessary infrastructure and skilled staff required to produce high-quality vaccines.
- There are 30 diagnostic laboratories in Odisha. The capacity of the diagnostic laboratories should be improved by replacing old and non-functional laboratory equipment, increasing staffing and upgrading the facilities.

3.2.4 Feed interventions

A feed balance assessment was conducted for the current situation in Odisha. The assessment found a 33% feed energy deficiency in the state (see Annexe, Table 39), with ruminants (cattle, buffalo, sheep and goats) being underfed. Sahoo and Dash (2020) argue that underfeeding is the main reason for the decrease in the production potential of animals in Odisha. It was also evident from the assessment that there are potential developments that can reduce feed insufficiency in the state. The major feed improvement interventions are:

i. Increase the utilization of crop residues as animal feed and improve the quality and nutritional value of crop residues.

Currently, crop residues are underutilized as livestock feed although a small portion of maize stover is being used. Farmers should be encouraged to increase the number of crop residues they use as livestock feed. Provision of chaff cutters and training will help farmers to use crop residues as livestock feed. Targeted utilization of crop residues (Table 12) could result in substantive increases in the availability of animal feed.

Table 12: Current and targeted percentage utilization of crop residues as animal feed

Crop residue	Current utilization (%) by production zone			Targeted utilization (%) by production zone		
	Hilly and mountain	Northwest	Coastal plain	Hilly and mountain	Northwest	Coastal plain
Rice	64	64	68	60	60	60
Wheat	5	3	NA	50	50	NA
Maize	28	43	30	50	50	50
Ragi	45	40	NA	50	50	NA
Green gram	44	53	58	70	70	70
Black gram	32	57	58	70	70	70
Horse gram	33	49	36	70	70	70
Cow pea	40	50	55	70	70	70
Groundnut	34	45	50	60	60	60
Sugarcane	15	13	12	50	50	50

Source: Swain et al. 2020

- In Odisha, chopping straw before feeding it to animals is rarely practised. It is well documented that feeding chopped crop residues to animals will increase milk productivity (Mahesh and Mohini 2014; Panda et al. 2015) and this practice should be promoted to farmers in the state. However, there are currently no companies producing chaff cutters or offering a repair service in Odisha. It is important to incentivize the chopper manufacturing industry.

- Promote urea-molasses treatment of crop residues. Crop residues have less than 4% protein content. Urea treatment of crop residues increases its nutritive value by raising the protein content to about 8%. Feeding urea-treated straw can reduce cattle feed requirements by up to 30%.

- Two feed block production units can be installed in the coastal plain and northwest production zones in Odisha. The wastage from crop residues can be used to prepare a complete feed block (total mixed ration [TMR]). In TMR, all feed ingredients, including roughage, are proportioned, processed and mixed into a uniform blend. Feed blocks can be prepared from almost all types of crop residues after suitable processing. A block-making unit comprises a chopper, grinder, mixer and compactor and feed blocks of 5–25 kg can be manufactured, depending on requirements. The formulation of the block can vary. If blocks need to meet only the maintenance requirements of animals, then the straw content could be as high as 80% and concentrate ingredients up to 20%. However, if the feed blocks are required to support milk production, then the straw component can vary from 30–50%, depending on the level of milk production. About 9–10 MT of feed blocks can be transported in a truck and shelf life is more than one year, if the moisture content is kept below 11%. The approximate cost of a block-making plant with a daily capacity of 15 MT is in the range of 25–35 lakh Indian rupees (INR).

ii. Increase fodder production and feeding

The total land available for fodder production in Odisha is only about 4,521 ha. About 3,876 ha is owned by private farmers and 645 ha by government fodder farms Bovine Breeding Research & Bull Mother (BBR & BM Farms, seed production farms and fodder demonstration farms). Only 49% of the total government fodder farm land is used to produce fodder. The different government fodder farms have varying utilization of land, which ranges between 44% and 72%.

- The aim is to increase the percentage of land utilized to between 80% and 90% by 2023/24. This land will be utilized for the production of fodder and fodder seeds and also used as demonstration sites.

- Fodder and fodder seed production can be done effectively in partnership with farmers. The fodder seeds produced from the government fodder farms can be distributed/sold to farmers. This can be part of the fodder production improvement strategy of the state, serving both as a demonstration site and a source of quality seeds.

- It is possible to increase the fodder production area of the land under private ownership, and the level of production (including season and perennial), through improved extension services and by educating farmers to cultivate perennial green forage as hedges or living fences in areas around houses, such as backyards, etc. This will also reduce women's workload as women are usually responsible for collecting fodder from the nearby forest, common property resources (CPRs) and wastelands. If a farmer uses all available land for fodder production, an average of about 0.05 ha extra land can be used for fodder production per farmer.

- The land area under permanent pasture/grazing/cultivable wasteland during 2020–21 was about 8,69,000 ha. The productivity of this land can be improved by over-sowing with improved grass and leguminous forage seeds and the use of fertilizer where applicable, under the control of community development groups. The aim is to increase rehabilitated permanent pasture/grazing land in the northwest and hilly and mountain production zones to 30% of the total permanent pastureland by 2025–26, to 50% by 2031–32 and to 70% by 2036–37.

- Development of forest areas should be done in consultation with the DAH & VS.

- Marketing, quality control and certification of forage seeds, forages and concentrates should be improved by strengthening existing regulatory bodies.

- There are eight fodder seed production farms under the control of the DAH & VS in Odisha. These fodder farms should be strengthened in the coming three years and become up to 90% operational (in terms of staffing, machinery, infrastructure, etc.). The farms will produce fodder and quality fodder seed and serve as demonstration sites. These farms can be developed in a public-private partnership (PPP) model.

iii. Increase concentrate feeding

To increase the productivity of lactating cows, additional concentrate feed supplementation is advised for crossbreed cows: 400 gm of concentrate (half cereal and half oil seed byproducts) can result in an additional 1 litre of milk. Concentrate supplementation of indigenous breed cows may be considered, although their response to the supplementation in terms of increased milk production should be observed carefully.

- Lactating crossbreed cows will receive an additional 1.2 kg concentrate feed (0.6 kg oil cake and 0.6 kg bran) per cow per day in the hilly and mountain and northwest production zones. In the coastal plain zone, the additional concentrate proposed for crossbreed cows will be about 2 kg (1 kg oil cake and 1 kg bran) per cow per day. By 2025–26, 30% of cows should be receiving concentrate supplementation and this should rise to 50% by 2030–31 and 70% by 2035–36.
- Lactating indigenous cows should be provided with an additional 0.5 kg concentrate feeds (0.25 kg oil cake and 0.25 kg bran) per cow per day in the hilly and mountain and northwest zones. In the coastal plain zone, the amount of concentrate fed to indigenous cows can increase by an additional 1 kg (0.5 kg oil cake/maize and 0.5 kg bran) per cow per day. As with lactating crossbreed cows, 30% of lactating indigenous cows should be receiving concentrate supplementation by 2025–26, 50% by 2030–31 and 70% by 2035–36.
- To fulfil these concentrate requirements, the additional indicative amount of concentrate that may be required will be 2,60,681 MT by 2025–26, 4,14,386 MT by 2030–31 and 5,40,331 MT by 2035–36.

3.2.5 Processing and marketing interventions

- There are currently 6,053 registered milk producer cooperative societies (MPCS) in Odisha, which have enrolled 2.57 lakh farmers, 1.00 lakh of whom are women. OMFED has organized 261 tribal women's dairy societies, enrolled 9,619 farmer members and collects 5.1 lakh litres of milk per day[8].
- Of the total MPCS, 15–20% own their own building for milk collection, milk testing and payment, while the rest rent facilities from private owners to act as cluster points (milk collection points), with milk tests and payment performed in designated locations. Only 1,100 MPCS have electronic milk testing machines.
- The milk collection capacity of OMFED is about 6.7 lakh litres/day. (Government of India 2021).
- Currently, a total of 8.8 lakh litres/day milk is collected/processed in Odisha: 5.1 lakh litres/day is collected/processed by OMFED and 3.7 lakh litres/day by private processors.
- Average milk procurement has risen from 3.66 lakh litres per day in 2020-21 to 4.60 lakh litres per day in 2021–22.
- On average, 3.23 lakh litres of milk and milk products were marketed per day in 2020-21 and 3.76 lakh litres/day in 2021–22.
- If only the installed capacity of OMFED is considered, the state has the capacity of processing about 10% of the total milk produced in the state.
- A fully automated 5 lakh litres/day capacity milk processing plant was installed in 2021 near the state capital by the State Government. As a result, the processing capacity in the state will increase to 20% of total milk production.

8. The times of India-https://bit.ly/3L1f8Zn

- The state's capacity for milk processing will increase from the current 13% of the total milk produced in the state to 20% in 2025–26, 25% in 2031–32, and 32% in 2036–37.
- The functional capacity and utilization of existing milk collection centres should be increased, including for testing for antibiotic residues.
- Bulk milk collection systems will be established to collect raw milk from producers and bulkers. About 140 bulk milk collection centres will be established by 2025–26, 160 by 2031–32 and 200 by 2036–37.
- An additional powder plant producing dairy whitener and condensed milk will be developed by 2025–26, with a further plant added between 2032 and 2037.
- The private sector should be encouraged to take part in the marketing and processing of milk.
- Modern retail trade points (or retail outlets) should be established by the industry to promote milk products; about 100 per year should be established over the next 15 years.
- Establish an innovation platform to link private milk traders, MCCs, cooperatives and processing plants.
- Introduce a mid-day meal scheme for 0.5 crore children and nursing mothers, with each receiving 100 ml milk per day for 200 days (approximately 20 litres of milk per person).
- Promote local products by incentivizing hotels, restaurants and cafeterias (HORECA segment) in the first five years.
- Introduce a quality enhancement program for the industry.
- Improve the collection system by incentivizing farmers in the hilly and mountain production zone and putting the unused assets of bulk milk coolers back on track in the first five years starting from 2022.

3.3 Animal-and herd-level assumptions and targets for the dairy sector

The following are animal- and herd-level intervention targets and assumptions for farmers adopting dairy improvement interventions in cattle. These assumptions and targets are the baseline animal- and herd-level parameters used for the modelling.

3.3.1 Assumptions

- The utilization of crop residue for livestock feed will increase.
- Interventions that improve the nutritional value of crop residues, such as chopping and urea-molasses treatment, will be practised.
- Farmers who are unable to meet their feed requirement from the additional utilization of crop residues will buy supplemental feeds such as concentrates.
- Lactating crossbreed cows will receive an additional 1.2 kg of concentrate feed (0.6 kg oil cake and 0.6 kg bran) per cow per day in the hilly and mountain and northwest production zones. In the coastal plain zone, the amount of concentrate fed to crossbreed cows will increase by an additional 2 kg (1 kg oil cake and 1 kg bran) per cow per day in response to increased milk production.
- Lactating indigenous cows will receive an additional 0.5 kg concentrate feed (0.25 kg oil cake and 0.25 kg bran) per cow per day in the hilly and mountain and northwest production zones. In the coastal plain zone, the amount of concentrate fed to indigenous cows will increase by an additional 1 kg (0.5 kg oil cake and 0.5 kg bran) per cow per day in response to increased milk production.

- The amount of land allocated to forage production by farmers of crossbreed cattle will increase to 0.05 ha per farmer. Perennial fodders (hybrid Napier grass and guinea grass) will be prioritized. Intensive extension services (educational, input and marketing) will be employed to encourage farmers to use all available areas around houses, hedges, fences, etc.
- Fodder seeds will be purchased for the additional land allocated to the production of fodder.
- Animals will have unrestricted access to clean drinking water 24 hours a day. This is particularly necessary for crossbreed cows.
- Cattle will be provided with an additional 30–50 g/day of an area-specific mineral mix and 30 g/day of common salt.
- Animals fed only on dry fodder will be provided with a urea-molasses mineral block to supplement their diet, depending on availability.
- Animals will be vaccinated for FMD, HS, BQ, brucellosis and anthrax.
- Animals will receive biannual external and internal parasite treatments as required; it is beneficial to deworm animals 2–3 weeks before vaccination to achieve a better immune response.
- Vaccination will be carried out at least a month before the likely occurrence of the disease.
- Vaccination of animals in advanced pregnancy may be avoided (although adverse effects are unlikely).
- Expenditure on veterinary services will increase by INR 500 per animal per year.

3.3.2 Targets

These assumed dairy improvement interventions should result in the following impacts at animal and herd levels.

- The parturition rate of cows will increase by 3%.
- The sex ratio at birth of female: male calves will be, on average, 80:20 in cows that receive AI using sexed semen and sex fixer treatments.
- The mortality rate will decrease by 30%.
- In indigenous cattle in all production zones the lactation length will increase from the current 200 days to 250 days.
- Milk production from indigenous cattle belonging to farmers who adopt the dairy improvement interventions will increase from the current 1, 1.6 and 2 litres/cow per day in the hilly and mountain, northwest and coastal plain production zones, respectively, to 2.25, 2.8 and 4 litres/cow per day.
- Milk production from crossbreed cattle will increase from the current 6, 6.5 and 7 litres/cow per day in the hilly and mountain, northwest and coastal plain production zones, respectively, to 9, 9.5 and 12 litres/cow per day.

3.4 Impact of interventions

3.4.1 Projected population

The impact of the above interventions on the size of the cattle population by 2035–36 is presented in Table 13. The results indicate that, overall, under the WI scenario, the crossbreed cattle population will increase by 112%, while the population of indigenous cattle will decrease by 25%. The crossbreed cattle population is expected

to grow by 115%, 110% and 106% in the coastal plain, hilly and mountain and northwest production zones, respectively. Under the BAU scenario, the overall crossbreed cattle population will increase by only 46%, and the indigenous cattle population will decrease by 11%.

Table 13: Comparison of current (2020–21) and BAU and WI projected (2035–36) cattle numbers

Production zone	Breed	Number of cattle (lakh)				
		Base year 2020–21	BAU 2035–36	Percentage change from base under BAU	WI scenario 2035–36	Percentage change from base under WI
Hilly and mountain	Indigenous breed	21.5	20.0	–7%	16.3	–24%
	Crossbreed	2.8	4.0	45%	5.8	110%
	Total	24.2	24.0	–1%	22.1	–9%
Northwest	Indigenous breed	27.8	25.0	–10%	20.8	–25%
	Crossbreed	4.0	5.8	45%	8.2	106%
	Total	31.8	30.8	–3%	29.0	–9%
Coastal plain	Indigenous breed	25.9	22.0	–15%	19.0	–27%
	Crossbreed	10.0	14.5	45%	21.4	115%
	Total	35.9	36.4	1%	40.4	13%
Commercial dairy		0.3	0.6	120%	0.6	132%
Total population	Indigenous breed	75.2	66.9	–11%	56.1	–25%
	Crossbreed	17.0	24.8	46%	36.0	112%
Grand total population		92.2	91.7	–0.5%	92.1	–0.1%

3.4.2 Projected production

Table 14 shows that milk production in the state during 2035–36 will increase by 140% in the WI scenario and 32% in the BAU scenario. Milk production from crossbreed cattle will increase by 177% (146.3 crore litres in 2020–21 to 406 crore litres) while it will increase by only 45% in the BAU scenario (146.3 crore litres in 2020–21 to 211 crore litres in 2035–36). Similarly, milk production from indigenous cattle will increase by 35% in the WI scenario, but it will decrease by 13% in the BAU scenario.

Table 14: Comparison of current (2020–21) and BAU and WI projected (2035–36) outputs

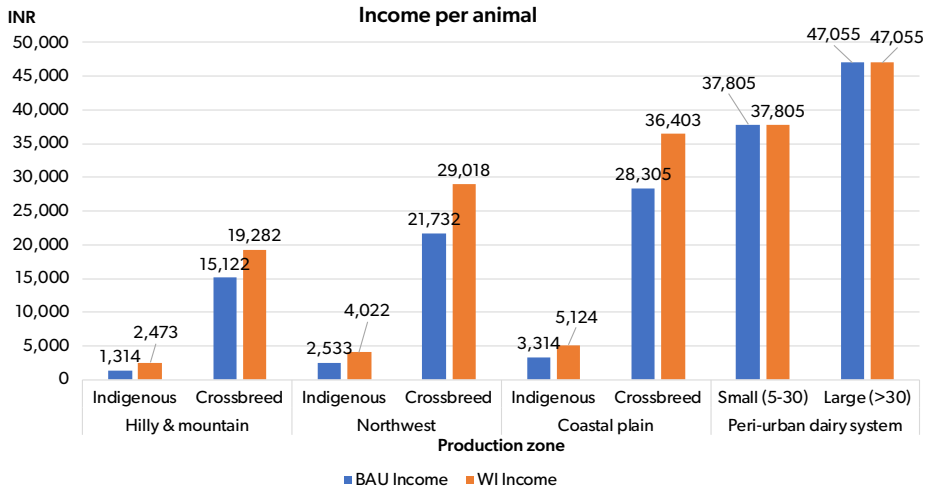
Products	Base year 2020–21	Production in 2035–36 under BAU	Percentage change from base under BAU	Production in 2035–36 under WI	Percentage change from base under WI
Milk from indigenous breed cows (crore litres)	50.8	44.3	–13%	68.4	35%
Milk from crossbreed cows (crore litres)	146.3	211.9	45%	405.9	177%
Milk from commercial dairy cows (crore litres)	4.0	8.7	119%	9.2	131%
Total milk (crore litres)	201.1	264.9	32%	483.4	140%
Manure (lakh MT)	276.5	277.6	0%	282.0	2%
Traction power (lakh days)	1,230.6	1,130.2	-8%	928.7	–25%

3.4.3 Projected income per animal

Figure 1 shows the projected annual income per animal in 2035–36 under the BAU and WI scenarios. Farm households engaged in commercial dairying will earn a higher annual income per animal than those using the traditional family dairy farming system. However, unlike the traditional family dairy system, there is no difference between the BAU and WI scenarios in terms of per animal income in 2035–36 for the commercial dairy system. This

is mainly because the management and technology differences between the BAU and WI scenarios are expected to be minimal in the commercial dairy system, which is also expected to already implement better management. In the commercial dairy system, the improvements are mainly linked to increases in the scale of production and the number of cattle in the system. Commercial dairy farmers with more than 30 cattle will earn INR 47,055 per animal, while farmers with 5–30 cattle will make INR 37,805 per animal in both WI and BAU scenarios. Across all production zones, farmers using the traditional family dairy system with indigenous cattle will earn a lower annual income per animal than those with crossbreed animals. For example, in the coastal plain zone, a family dairy farming system using crossbreed cattle will earn INR 28,305 per animal under the BAU scenario and INR 36,403 per animal under the WI scenario, while farmers using indigenous cattle will make about INR 3,314 under the BAU scenario and 5,124 under the WI scenario.

Figure 1: Projected annual income (crore) per animal by 2035–36 under the BAU and WI scenarios.



Source: LSS results

3.4.4 Return on investment

Table 15 shows financial indicators for the dairy investment. The investment takes into consideration the introduction of a school mid-day milk subsidy by the government (a scenario without the mid-day milk subsidy is presented in the Annexe, Table 41). The net present values (NPVs) for the traditional family and commercial dairy farming systems are positive in all production zones, indicating the positive impact of the investment. The NPV is higher for the commercial dairy farming system. Higher NPVs are also observed among farms with crossbreed cattle. The internal rate of return (IRR) shows a positive trend in all production zones . A higher IRR is observed among small commercial dairy farming systems with 5–30 cattle and dairy farms in the coastal plain zone.

Table 15: Farm-level NPV and IRR evaluation for family and commercial dairy production in Odisha in 2035–36 under the WI scenario with school mid-day meal

Production zone	Breed/size	Financial indicators based on 15-year discounted incremental cash flow analysis	
		NPV (thousand INR)	IRR (%)
Hilly and mountain	Indigenous breed family dairy	1.15	8%
	Crossbreed family dairy	68.15	24%
Northwest	Indigenous breed family dairy	1.34	9%
	Crossbreed family dairy	70.42	25%
Coastal plain	Indigenous breed family dairy	8.68	18%
	Crossbreed family dairy	193.69	35%
Commercial dairy	Small	407.58	81%
	Large	2,044.13	70%

3.4.4 GSDP contribution for all dairy products

As shown in Table 16 below, the GSDP contribution of dairy production will grow from INR 16,359 crore in the BAU scenario to 22,517 in the WI scenario. Most of the gain in the GSDP contribution is due to the increase in milk production from crossbreed cattle, not in commercial dairy operations.

Table 16: GSDP contribution of dairy sector for 2020–21 and 2035–36 under BAU and WI scenarios

	GSDP contribution (crore INR)				
Products	Base year 2020–21	BAU 2035–36	Percentage change from base under BAU	WI 2035–36	Percentage change from base under WI
Milk					
Indigenous breed family dairy	794.7	690.1	–13%	1,490.6	88%
Crossbreed family dairy	3,764.8	5,419.6	44%	10,496.7	179%
Commercial dairy	103.4	225.9	118%	238.3	130%
Total milk	4,662.9	6,335.6	36%	12,225.5	162%
Manure	5,527.4	5,548.4	0%	5,635.9	2%
Traction power	6,168.5	5,663.5	–8%	4,655.2	–25%
Total	16,358.7	17,547.5	7%	22,516.7	38%

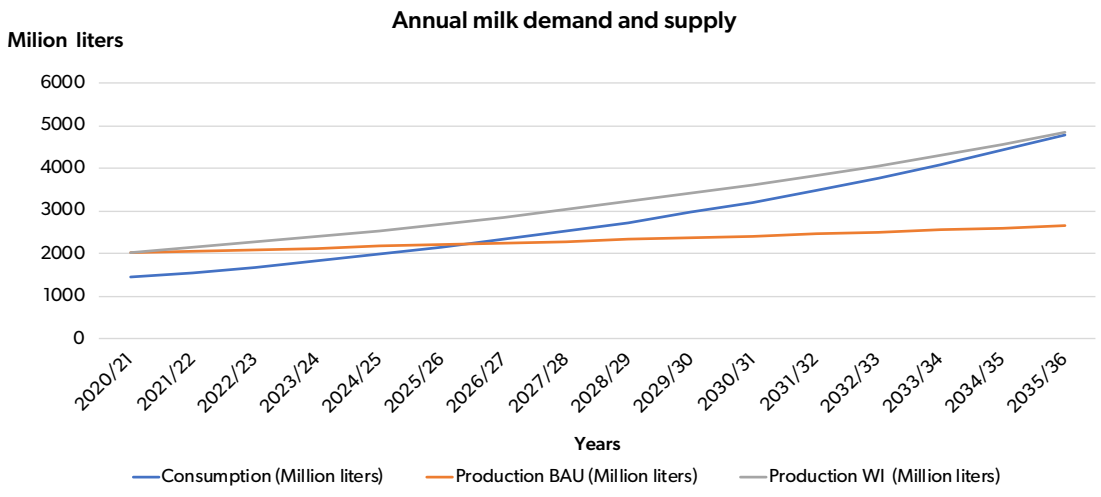
Note: Farmgate values are used as product values to estimate GSDP. For manure and traction power, the productions will be valued when the manure or the traction power is used at home or sold/rented directly.

3.4.5 Future milk production-consumption balance

Between 2020–21 and 2035–36 under the BAU scenario, both milk demand and production are expected to increase annually by 8.3% and 2%, respectively. Production in 2020–21 is higher than consumption, indicating surplus production already exists and is being marketed outside Odisha. The projection shows that, under the BAU scenario, the excess supply of milk will continue for 5–6 years before milk consumption overtakes production in 2025–26. Due to changes in human population, urbanization and incomes, milk consumption is projected to grow from 144 crore litres in 2020–21 to 478 crore litres in 2035–36.

Additional investments (the WI scenario) targeting the dairy cow sector to increase milk production would be required to increase milk supply and more closely align it with projected consumption. With the additional investment, the projected milk supply will remain larger than projected consumption through the period evaluated (Figure 2), although the two quantities are projected to be roughly equal by 2035–36.

Figure 2: Future production-consumption balance in milk and milk products under BAU and WI scenarios.



3.4.6 Gender and social inclusion implications in the dairy sector value chain development[9]

Smallholders produce nearly 80% of the milk produced in Odisha, and under the Flood II program, OMFED has organized around 1.5 lakh women in 1,292 dairy cooperatives. However, gendered division of labour places women in low-skilled positions with limited processing and marketing responsibilities (Das 2015). Active efforts are required to include women in processing and marketing, duly supported by training in production, leadership, marketing and other skills, to ensure equal opportunities.

Women can be further empowered by carefully designed interventions and investments, such as in technologies that reduce menial work, allowing them to do more productive work, or in feed technologies that are accessible, affordable and acceptable, for instance, training female dairy farmers in azolla cultivation and balanced feed formulation. Investments in extension work reaching female dairy farmers are crucial and should include approaches that factor in the differential needs and capabilities of men, women and youth, including the tribal and marginalized communities. The promotion of gender and social inclusion strategies in marketing chains is needed to ensure the participation of women in various roles and not just as producers of milk.

Forming linkages with other departments, such as the dairy development department, and the private sector is recommended to facilitate the training of women in food safety and hygienic milking practices, entrepreneurial and technical skills in product development, and ASF value addition (e.g. ghee, paneer, sweets, etc.).

9. Livestock sector investment and policy toolkit used for the modeling does not include gender variables. Therefore, gender analysis was done based on key informant interviews, and stakeholder discussion.

4 Red meat improvement intervention targets and impact (goats and sheep)

4.1 The investment context

There are large numbers of goats and sheep in Odisha. The state has the ninth largest goat population in India, following Tamil Nadu and Jharkhand (Government of Odisha 2021b). As in other Indian states, goats and sheep in Odisha are reared in a traditional subsistence manner by some sections of society (marginal and landless labourers) who are unable to rear large animals (LAC 2020). This traditional way of keeping small ruminants results in high mortality and low productivity. Thus, the red meat improvement intervention focuses on reducing mortality in addition to improving parturition and prolificacy rates through feed improvement (feed availability and quality) and health services (primarily vaccination).

4.2 Interventions and targets at state and production zone levels

All the red meat improvement interventions will be implemented in all livestock production zones (hilly and mountain, northwest and coastal plain).

4.2.2 Genetic improvement interventions

- Improve local breed goats and sheep through selective breeding.
- In Odisha, there are six goat breeding farms and one sheep breeding farm under the DAH & VS. These breeding farms should be strengthened in the coming five years to improve their capacity to develop and multiply improved local goat and sheep breeds. Genetic screening of the goat and sheep population should be used to identify the best animals for further improvement
- Strengthen and promote private breeding farms to generate improved goats and sheep. Breeding of goats and sheep should continue as per the 2002 Orissa State Livestock Sector Policy (Government of Orissa 2002).
- A specific breeding policy should be developed for goats and sheep.
- Community-based in-situ strategies to improve indigenous goat and sheep breeds should include women given their vast knowledge and experience (strategies could include creating 'best farmer' awards for breed improvement in each district, or encouraging the exchange of the best bucks through animal '*mela*' or shows, etc.)

- Build awareness among female farmers to improve the availability of quality breeding bucks in a flock. According to Siddiky (2017), the current buck to breeding female ratio in India is about 1:100, against the recommended 1:40. The LSA indicates that the buck to breeding female ratio in Odisha is about 1:60.
- Train farmers to retain the best bucks for breeding and avoid selling them for slaughter. To prevent inbreeding, it is advisable not to use these bucks for breeding for more than two years in the same village. Farmers from different villages could exchange breeding bucks.
- Implement AI for goats and sheep in collaboration with research institutes.

4.2.3 Research interventions

- Interventions to improve research infrastructure and investment in the dairy sector will also cater to other species, including goats and sheep.

4.2.4 Extension interventions

- Focus on reaching out to women and marginalized communities. Provide training to WSHGs at venues closer to their homes that offer childcare facilities for young children, and have separate bathrooms. In this context, ICT can strengthen the linkage between extension, research and farmers, and DAH & VS needs to acquire appropriate communication and training material to make use of ICT tools (smartphones, cell phones, radio, TV, internet) in offering extension and advisory services to female farmers.
- All training centres (both existing and those that are to be established) that offer training for graduate- and diploma-level extension workers will also provide training in goat and sheep production improvements. The trainers will receive gender sensitization training so that they are aware of the differential training needs of men, women and youth and provide need-based training.
- Extension departments at different levels will provide public extension services and support, and will control and regulate private extension services.
- In the first two years of the plan, the necessary acts, regulations, guidelines and manuals will be developed/improved to enable extension service providers to expand more quickly. Bureaucratic processes that hinder the creation and continuation of service provision should be eased to help in providing services ethically and responsibly.
- The coverage of consistent goat and sheep improvement training will reach 50% by 2025–26, 70% by 2030–31 and 80% by 2035–36. Farmers will receive more intensive and continuous training on goat and sheep management (feeding, breeding, deworming, disease control, etc.). Breed improvement training may include selecting animals to breed, maintenance of breeding bucks, kid care, castration of kids, etc.
- Strengthen the telecommunication extension service. Introduce ICT for mobile clinics and feeding interventions using SMS/WhatsApp.

4.2.5 Health interventions

- Interventions recommended to improve/increase access to veterinary hospitals/polyclinics, veterinary dispensaries and veterinary aid centres in the dairy sector will cater to all species, including goats and sheep.
- Goats and sheep should receive vaccinations for critical diseases such as peste des petits ruminants (PPR), goat pox, enterotoxaemia (ET) and FMD.

- Currently, about 80% of goats receive vaccinations for PPR and FMD through public campaign programs. The aim is to have full vaccination coverage for these diseases by 2025–26. Adoption of vaccination for other diseases, such as ET and goat pox, is targeted to increase to 50% by 2025–26 and 90% by 2030–31 and 2035–36. To facilitate the vaccinations, a PPP model (utilizing Prani Mitras) can be adopted.
- The proportion of farmers adopting the recommended external and internal parasite control treatments will reach 80% in the coming 15 years.
- Private veterinary service providers, including Pashu Sakhis and Prani Mitras, should be supported and promoted by the government.
- Animal mortality resulting from flooding and cyclones can be reduced by improving early warning and awareness systems and establishing livestock shelters in cyclone/flood-prone districts.

4.2.6 Feed interventions

The feed balance assessment showed that ruminants (cattle, buffalo, sheep and goats) were not receiving sufficient food to fulfil about 33% of their energy demand. Potential improvements to decrease feed insufficiency in the state include:

i. Increasing the utilization of crop residues as animal feed and improving the quality of crop residues.

- All the interventions recommended to increase the utilization of crop residues as animal feed in the dairy sector are equally relevant for all species, including goats and sheep.
- The nutritional quality of crop residues fed to animals can be improved by promoting urea treatment and chopping of crop residues.

ii. Increase fodder production and improve pasture/grazing areas.

- Promote azolla propagation and use by farmers.
- Improve the use of spineless cactus (as promoted by the International Center for Agricultural Research in the Dry Areas [ICARDA])
- The forest department should consult the livestock department and, where possible, plant fodder trees during afforestation and tree plantation drive to increase the availability of animal feed.
- The area of land under permanent pasture/grazing, cultivable wasteland and barren land in 2020–21 was about 17 lakh ha. The productivity of this land can be increased by over-sowing with improved grass and leguminous forage seeds and the use of fertilizer where applicable. The aim is to increase the area of rehabilitated permanent pasture/grazing land to 50% of the total permanent pastureland by 2025–26, 70% by 2030–31 and 80% by 2035–36
- Improve production, marketing and quality control of forage seeds, forages and concentrates by strengthening existing regulatory bodies.

iii. Strategic concentrate feeding of goats and sheep

The total indicative amount of concentrate required in Odisha for cows, goats and sheep is presented in the feed section of recommended dairy improvement interventions.

- Does and ewes should be fed 200 g of concentrate daily for one month before and after parturition to increase milk production and improve the survival of kids and lambs.
- During peak summer when feed is scarce, milking ewes and does in the coastal plain zone should be supplemented with 100 g/day of concentrate.

- The proportion of farmers adopting the additional supplementary concentrate feeding will reach 50% by 2025–26, 70% by 2030–31 and 80% by 2035–36.

4.2.7 Processing and marketing interventions

- A total of 60 small abattoirs, each with a capacity of 20–30 animals per day, will have to be established in the coming 15 years. Each city with more than 5 lakh inhabitants should have an abattoir. Five small-scale goat and sheep slaughterhouses will be established each year in the municipalities and urban bodies, and subsequently, all the district headquarters will have this type of certified slaughterhouses. In total, 25 will be established by 2025–26, another 25 by 2030–31 and 10 more by 2035–36.
- A total of eight goat and sheep model scientific abattoirs should be established in the next 15 years mainly to meet the needs of the new e-commerce model of meat delivery (see, for example, www.emeat.in). Three should be established by 2025–26, in Bhubaneswar, Cuttack and Rourkela, with a further three established by 2030–31 and the remaining two by 2035–36.
- One incubation centre for the start-up of the animal protein market should be established as part of the proposed Fisheries and Veterinary sciences university.
- A total of 360 livestock markets will be established within mandis in the coming 15 years: 314 of these markets will be established within blocks and the remaining 56 in other areas where the mandi markets flourish. Each mandi/market will have spaces allocated for live animal/bird trade and will also have a small slaughterhouse where consumers can purchase directly from the farmers and have the animals processed.
- Using the experience of the Falcon model, two goat and sheep meat processing plants will be established in the coming 10 years. One will be established in the first five years and the second one in the second five years.
- New retail outlets for selling meat/animal protein will be established with subsidy components from the government to offer employment to young people. The plan is to establish 100 outlets per year. The investment required would be INR 80,000 per outlet. The subsidy component would be INR 0.2 crore per year.
- The local goat breed will be promoted by designating it as superior meat for export, following the example of Bakri (promoting the Himalayan goat) in Uttarakhand.
- Five tanneries for handling hides and skins will be established, two by 2025–26, two more by 2030–31 and the final one by 2035–36. Each tannery will have the capacity to treat 5,000 sheep/goat skins/hides per day and a collection system will be established. To prevent loss of raw material, butchers will be trained to clean hides/skins and treat them with salt/turmeric and prevent them getting damp.

4.3 Animal- and herd-level assumptions and targets for goats and sheep

The following are animal- and herd-level intervention targets and assumptions for farmers adopting red meat improvement interventions in goats and sheep.

4.3.1 Assumptions

- The percentage of crop residue used for livestock feed will increase. Additional feed sources like azolla, spineless cactus and others will be used.
- Ewes and does will be fed 200 g of concentrate daily for one month before and one month after parturition to increase milk production, improve survival of lambs/kids and increase preweaning weight.

- During peak summer, when feed is scarce, milking ewes and does will be supplemented with concentrate.
- Each animal will be provided with 5 g/day of mineral supplementation and common salt in the form of molasses mineral blocks.
- Animals will be provided with sufficient water.
- A sufficient number of bucks will be made available all year around.
- Farmers will be trained to keep the best bucks for breeding rather selling them, and not to use breeding bucks for more than two years.

4.3.2 Targets

Farmers adopting the above interventions should observe the following impacts on their goats and sheep at the animal and farm level.

- The parturition rate of sheep is expected to increase by 15%. However, the parturition rate of goats may not change as the baseline is already very high (1.5 kids/year).
- Mortality of both goats and sheep will decrease by 30–40%.
- The live weight of goats and sheep will increase by 10–15%.
- The price of skins will increase by 20–30% as a result of improved skin quality following adoption of external parasite treatment/control.
- There is scope for farmers to obtain milk from the Ganjam goat.
- The veterinary cost of goats and sheep will increase by about INR 20/animal per year (see Annexe, Table 37, for vaccination and external and internal parasite treatment costs).

4.4 Impact of interventions

4.4.1 Goats

4.4.1.1 Projected population

Table 17 compares the current (2020–21) and BAU and WI projected (2035–36) goat numbers. The projection indicates that under the WI scenario the goat population in Odisha will increase by 75.6%. The greatest increase in goat population is observed in the northwest zone (81%), followed by the hilly and mountain (79%) and coastal plain (59%) zones. It is important to note that the number of goats will increase by 88% among households already keeping more than 10 goats, while it will increase by 73% among households keeping fewer than 10 goats. Under the BAU scenario, the goat population will decline by 1.6% in Odisha.

Table 17: Comparison of current (2020–21) and BAU and WI projected (2035–36) goat numbers

Production zone	Average flock size	Number of goats (lakh)				
		Base year 2020–21	BAU 2035–36	Percentage change from base under BAU	WI scenario 2035–36	Percentage change from base under WI
Hilly and mountain	Small (1–10)	12.7	13.9	10%	22.0	73%
	Large (>10)	3.2	3.2	3%	6.4	102%
	Total	15.8	17.2	9%	28.4	79%

Production zone	Average flock size	Number of goats (lakh)				
		Base year 2020–21	BAU 2035–36	Percentage change from base under BAU	WI scenario 2035–36	Percentage change from base under WI
Northwest	Small (1–20)	26.7	25.9	–3%	47.8	79%
	Large (>20)	6.7	6.5	–3%	12.6	89%
	Total	33.3	32.4	–3%	60.4	81%
Coastal plain	Small (1–10)	11.6	10.4	–10%	18.1	56%
	Large (>10)	2.9	2.6	–12%	4.9	69%
	Total	14.5	13.0	–10%	23.0	59%
Total population	Small	50.9	50.3	–1%	87.8	73%
	Large	12.7	12.3	–3%	23.9	88%
Grand total population		63.6	62.6	–1.6%	111.8	75.6%

Source: LSS results

4.4.1.2 Projected production

The production of goat meat, milk, organic matter and skin after 15 years WI and under the BAU scenario is presented in Table 18. The results show that goat meat production will increase by 90% (from 32,223 MT in 2020–21 to 61,312 MT in 2035–36) under the WI scenario but will decrease by 2% (from 32,223 MT in 2020–21 to 31,703 MT in 2035–36) under the BAU scenario. The increase in meat production resulting from the additional investment is highest in the hilly and mountain zone (98%), followed by the northwest zone (95%). Without additional investment, goat meat production will decrease by 10% in the coastal plain zone and by 2% in the northwest zone, although it will increase slightly (by 9%) in the hilly and mountain zone.

Table 18: Comparison of current (2020–21) and BAU and WI projected (2035–36) goat production

Products	Production				
	Base year 2020–21	BAU 2035–36	Percentage change from base under BAU	WI 2035–36	Percentage change from base under WI
Goat meat (MT)					
Hilly and mountain	7,474.6	8,115.6	9%	14,796.6	98%
Northwest	17,277.4	16,879.2	–2%	33,612.7	95%
Coastal plain	7,471.2	6,708.6	–10%	12,902.5	73%
Total goat meat production (MT)	32,223.2	31,703.4	–2%	61,311.8	90%
Goat milk (lakh litres)	6.2	6.1	–2%	10.6	72%
Organic matter (MT)	1,85,220	1,76,588	–5%	3,20,936.3	73%
Skins (MT)	2,436	2,376	–2%	5,848.7	140%

Source: LSS results

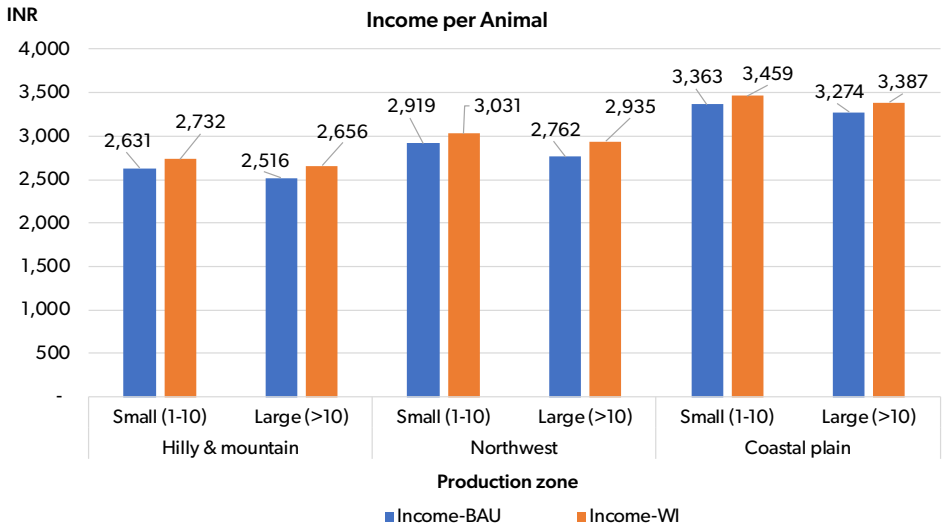
4.4.1.3 Projected income per goat

Figure 3 shows the projected income per goat after 15 years (2035–36) under the WI and BAU scenarios. The income per goat is highest in the coastal plain zone and lowest in the hilly and mountain zone. The main reason for higher income in the coastal plain zone is the higher prices paid for meat compared with other zones. In the coastal plain zone, the income per animal for farms with fewer than 10 goats is INR 3,363 in the BAU scenario and 3,440 in the WI scenario (an increase of 2.83%). For farms with more than 10 goats, the income per animal is INR 3,274 in the BAU scenario and INR 3,387 in the WI scenario.

In the hilly and mountain zone, the income per animal for farms with fewer than 10 goats will be INR 2,631 in the BAU scenario and INR 2,732 in the WI scenario. Similarly, there will be a slight increase in the income per goat due to additional investment in the northwest zone (from INR 2,919 in the BAU scenario to INR 3,031 in the WI scenario).

Overall, therefore, the major impact of investment in the goat sector is an increase in population rather than per animal income. This goat value chain intervention stands to benefit women the most since many own goats and are able to make decisions about their herds.

Figure 3: Projected annual income (crore) per animal by 2035–36 under BAU and WI scenarios.



Source: LSS results

4.4.1.4 Return on investment

Table 19 shows that the NPVs for all systems in all production zones are positive in 2035–36, indicating the positive impact of investment. Farms with more goats in the northwest zone have the highest NPVs, while households with fewer goats in the hilly and mountain zone have the lowest NPVs. The IRR shows a positive trend in all production zones (Figure 3).

Table 19: Farm-level NPV and IRR evaluation for goat production in Odisha in 2035–36 under the WI scenario

Production zone	Goat production unit size	Financial indicators based on 15-year discounted incremental cash flow analysis		
		Average flock size	NPV (thousand INR)	IRR (%)
Hilly and mountain	Small	4.5	5.7	23%
	Large	15	42.9	34%
Northwest	Small	4.5	12.6	35%
	Large	23	74.7	38%
Coastal plain	Small	4	10.5	32%
	Large	15	49.5	36%

Source: LSS results

4.4.1.5 GSDP contribution of goat production

In the WI scenario, the GSDP contribution of the goat meat production system rises from INR 1,858.7 crore in the base year (2020–21) to INR 3,385 crore in 2035–36, an increase of 82% (see Table 20). In contrast, under the BAU scenario, the GSDP contribution will decrease by 2% (from INR 1,858 crore in 2020–21 to 1,822 crore in 2035–36).

Table 20: GSDP contribution of goat sector for 2020–21 and 2035–36 under BAU and WI scenarios

Products	GSDP contribution (crore INR)				
	Base year 2020–21	BAU 2035–36	Percentage change from base under BAU	WI 2035–36	Percentage change from base under WI
Goat meat GSDP contribution					
Hilly and mountain	406.2	441.1	9%	766.9	89%
Northwest	970.1	947.7	–2%	1,816.5	87%
Coastal plain	482.4	433.2	–10%	802.0	66%
Total goat meat GSDP contribution	1,858.7	1,822.0	–2%	3,385.3	82%
Goat milk	2.9	2.9	–2%	4.9	67%
Manure	23.7	22.6	–5%	41.1	73%
Skins	13.5	13.2	–2%	32.5	140%

Source: LSS results

4.4.1.6 Gender and social inclusion implications for goat value chain development

Goat farming constitutes the main occupation or livelihood strategy for more than 25% of Odisha's rural population, especially women in tribal regions (Government of Odisha 2021b). For most female farmers, goats are a 'moving bank', acting as a cashable asset for education and medical expenses, a source of food for household nutrition, and a living asset to support agriculture at times of need.

Since women play an important role in goat farming and more than 80% of goat production is in the hands of female farmers, developing female goat farmers as entrepreneurs is a step in the right direction. This can be achieved by forming goat producer groups or FPOs and integrating them with Mission Shakti. Female goat farmers should also be involved in breeder associations given their considerable knowledge of goat keeping. There is scope for youth from marginalized and tribal communities to take up semi-intensive goat farming as a commercial enterprise. However, government schemes and policies targeted at poor and marginalized livestock farmers should not mandate land ownership as a prerequisite to receiving a goat, BYP or even cattle, as women and youth rarely have land registered in their names.

Women should be enabled to access forests and develop CPRs to increase the availability of green fodder, which in turn will increase the productivity of goats. Introducing women to, and training them in, simple technologies like the cultivation of azolla, making mineral blocks and feed/fodder ration formulation can reduce feed costs and enhance productivity and incomes. The DAH & VS should invest in supporting community fodder banks and providing training, extension and professional education to men and female farmers. The environment, forest and climate change department should be encouraged to plant fodder trees where possible during tree plantation drives and afforestation programs to increase fodder production.

The proposed policy actions to improve the goat sub-sector include improving animal health, nutrition and breeding service delivery, enhancing the availability of quality feed, effective policy for better utilization of CPRs, strengthening goat breeding farms and fodder farms, and enhancing access to input and output markets[10] by encouraging the formation of FPOs. Women's participation and leadership roles in existing or new livestock-related groups should be strengthened through the introduction of rules governing matters such as rotating leadership and percentage representation on the board, etc.

10. Needs assessment of smallholder goat farmers in Odisha, India D-BRIEF from MIT D-Lab Scale-Ups – Spring 2016

4.4.2 Sheep

4.4.2.1 Projected population

Table 21 shows the change in the sheep population in the different production zones under the WI and BAU scenarios. Compared with the base year, the sheep population in Odisha in 2035–36 will increase by 76% with additional investment, while it will decrease by 10% in the BAU scenario.

The coastal plain zone will see the greatest impact from investment (about 97% increase) followed by the hilly and mountain zone (88%) and the northwest zone (46%). It is important to note that a bigger increase in sheep population (about 80%) is observed among farm households with fewer than 10 sheep compared with farm households with more than 10 sheep, which have a population growth of 67%.

Table 21: Comparison of current (2020–21) and BAU and WI projected (2035–36) sheep numbers

Production zone	Breed	Livestock population				
		Base year 2020–21	BAU 2035–36	Percentage change from base under BAU	WI 2035–36	Percentage change from base under WI
Hilly and mountain	Small (1–10)	3.5	3.5	2%	6.5	89%
	Large (>10)	1.5	1.5	1%	2.8	87%
	Total	5.0	5.0	2%	9.3	88%
Northwest	Small (1–20)	2.5	2.1	–17%	3.7	50%
	Large (>20)	1.7	1.3	–23%	2.3	40%
	Total	4.2	3.4	–19%	6.1	46%
Coastal plain	Small (1–10)	2.4	2.0	–16%	4.7	97%
	Large (>10)	0.6	0.5	–17%	1.2	95%
	Total	3.0	2.5	–16%	5.9	97%
Total population	Small	8.4	7.6	–9%	15.0	80%
	Large	3.7	3.3	–12%	6.3	67%
Grand total population		12.1	10.9	–10%	21.3	76%

Source: LSS results

4.4.2.2 Projected production

The production of sheep meat, organic matter and skin after 15 years in the WI and BAU scenarios is presented in Table 22. The results show that with additional investment there will be a 92% increase in meat production (from 5,612 MT in 2020–21 to 10,786 MT in 2035–36). In the BAU scenario, sheep meat production will decrease by 10%, from 5,612 MT in 2020–21 to 5,024 MT in 2035–36. The biggest proportional increase in sheep meat production is observed in the coastal plain zone (117%) followed by the hilly and mountain zone (107%) and the northwest zone (52%).

Table 22: Comparison of current (2020–21) and BAU and WI projected (2035–36) sheep production

Products	Production				
	Base year 2020–21	BAU 2035–36	Percentage change from base under BAU	WI 2035–36	Percentage change from base under WI
Sheep meat production (MT)					
Hilly and mountain	2,129.0	2,164.1	2%	4,409.6	107%
Northwest	1,809.1	1,459.1	–19%	2,742.1	52%
Coastal plain	1,673.7	1,401.2	–16%	3,634.6	117%
Total sheep meat production (MT)	5,611.8	5,024.3	–10%	10,786.2	92%

Production					
Products	Base year 2020–21	BAU 2035–36	Percentage change from base under BAU	WI 2035–36	Percentage change from base under WI
Organic matter (MT)	3,538.0	39,225.8	–10%	76,476.4	76%
Skins (MT)	243.0	217.7	–10%	668.4	175%

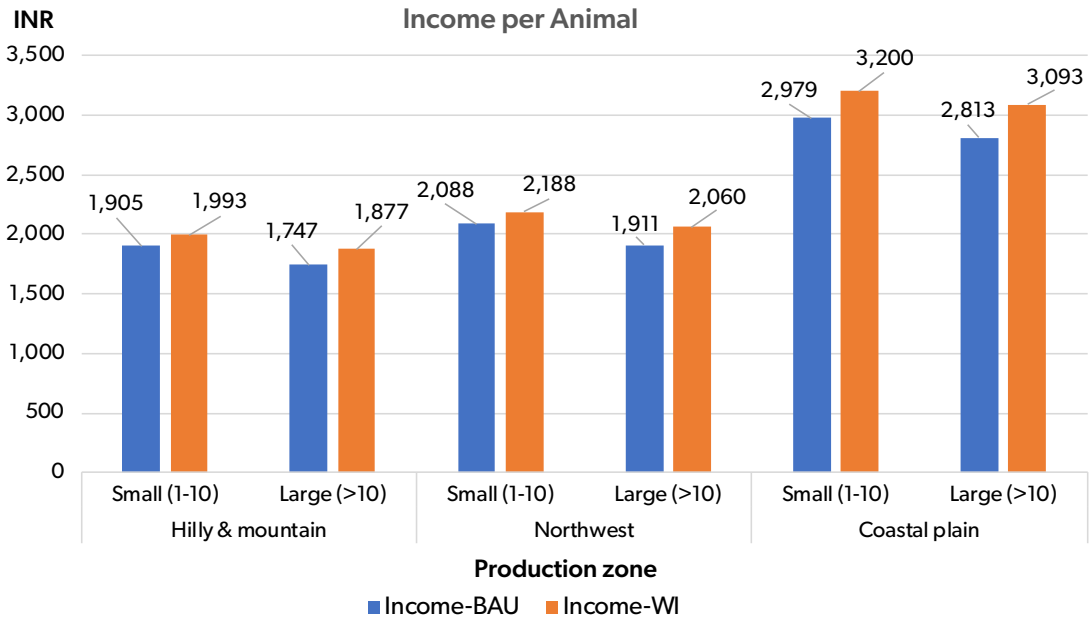
Source: LSS results

4.4.2.3 Projected income per sheep

The projected income per sheep in 2035–36 under the WI and BAU scenarios is presented in Figure 4. The results show that the income per animal is highest in the coastal plain zone, resulted from the higher price of sheep in the coastal than in the other production zones of the state. In family sheep production systems with fewer than 10 sheep in the coastal plain zone, the income per animal is INR 2,979 in the BAU scenario and INR 3,200 in the WI scenario, an increase of 7.41% as a result of the investment. In commercial sheep production systems with more than 10 sheep, the income per animal is INR 2,813 in the BAU scenario and INR 3,093 in the WI scenario.

In the hilly and mountain zone, where the income per animal is lower, the income per animal for farms with fewer than 10 sheep will be INR 1,905 in the BAU scenario and INR 1,993 in the WI scenario. The difference in sheep per animal income between WI and BAU (2035-36) scenarios is the highest in the Coastal plain zone, followed by the Northwest zone.

Figure 4: Projected annual income (crore) per animal by 2035–36 under BAU and WI scenarios.



Source: LSS results

4.4.2.4 Return on investment

Table 23 shows that the NPVs for sheep meat production are positive in both small and large units across all production zones. Large sheep production systems in the coastal plain and northwest zones have relatively higher NPVs. The IRR is positive and financially viable. However, investments in the coastal plain zone are about twice as rewarding.

Table 23: Farm-level NPV and IRR evaluation for sheep meat production in Odisha in 2035–36 under the WI scenario

Production zone	Sheep production unit size	Average flock size	Financial indicators based on 15-year discounted incremental cash flow analysis	
			NPV (thousand INR)	IRR (%)
Hilly and mountain	Small	4.5	6.8	24%
	Large	10	15.1	24%
Northwest	Small	5	7.3	24%
	Large	25	34.8	24%
Coastal plain	Small	5	24.0	44%
	Large	15	71.5	44%

Source: LSS results

4.4.2.5 GSDP contribution of sheep production

In the WI scenario, the GSDP contribution of the sheep meat production sector increases by 82.1% from INR 281.8 crore in the base year (2020–21) to INR 512.9 crore in 2035–36 (Table 24). However, in the BAU scenario, the GSDP contribution will decrease by 11% from INR 281.8 crore in 2021–21 to INR 250 crore in 2035–36.

Table 24: GSDP contribution of sheep sector for 2020–21 and 2035–36 under BAU and WI scenarios

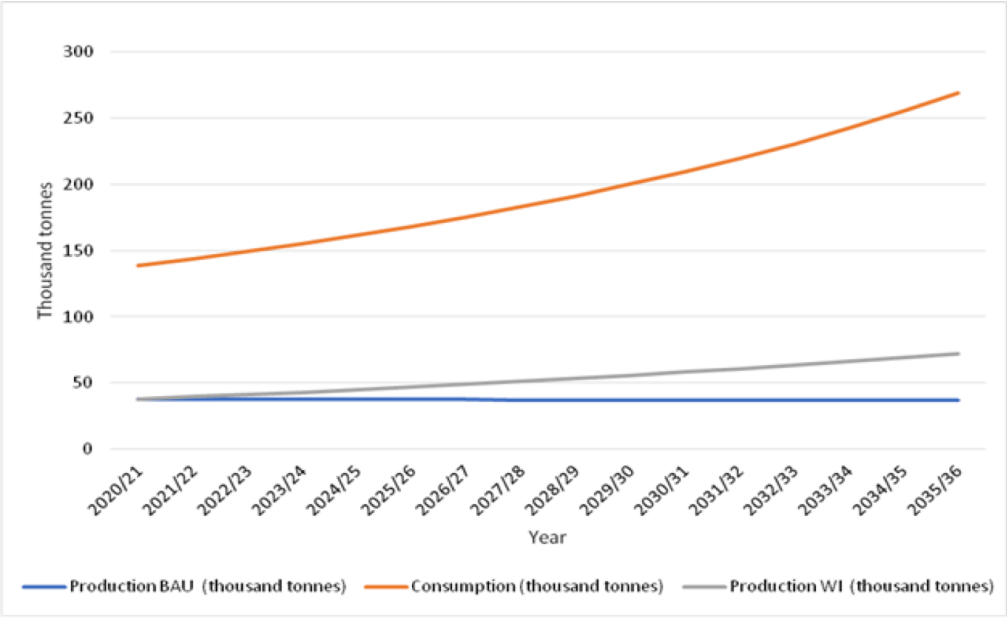
	GSDP contribution (crore INR)				
Products	Base year 2020–21	BAU 2035–36	Percentage change from base under BAU	WI 2035–36	Percentage change from base under WI
Sheep meat					
Hilly and mountain	94.9	96.4	2%	184.3	94%
Northwest	94.4	76.1	–19%	135.3	43%
Coastal plain	92.5	77.5	–16%	193.3	109%
Total sheep meat	281.8	250.0	–11%	512.9	82%
Manure	5.7	5.1	–10%	9.9	76%
Skins	0.5	0.5	–10%	1.4	175%

Source: LSS results

4.5 Future red meat production-consumption balance

The future production-consumption balance for goat and sheep meat is presented in Figure 5. As the result of an increase in human population, urbanization and incomes, the quantity of goat and sheep meat demanded in Odisha State is projected to increase by 93.53% from a baseline level of about 1.39 lakh MT in 2020–21 to 2.69 lakh MT equivalent by 2035–36. Meanwhile, over the same period, the quantity of red meat (both goat and sheep meat) produced is predicted to decrease by 2.12% without additional investment (BAU) and increase by 90.5% in the WI scenario. Due to the projected rapid increase in demand for red meat, it will not be possible to align production with potential consumption by 2035–36 even with additional investments and interventions. However, given the technology options presently available and the low additional return on investment under the WI scenario compared with BAU, small ruminant rearing currently is a key life-changing option for marginalized farmers and especially women, who are either going into goat production for the first time or can expand their herd sizes.

Figure 5: Future production-consumption balance in red meat (both goat and sheep) under BAU and WI scenarios.



Source: LSS results

5 Poultry improvement intervention targets and impacts

5.1 Improving backyard chicken production

Interventions to improve the backyard desi chicken can be practised across Odisha, and in all the livestock production zones (hilly and mountain, northwest and coastal plain).

5.1.1 Interventions and targets at the state level

The current average backyard desi chicken flock size in Odisha is about 2.5 hens. The aim is to increase the average flock size to 3.5 hens in the first five years of the program and to 4 by the 10th year.

The total desi chicken population is predicted to grow faster under the WI scenario than under the BAU scenario (Table 25). In the BAU scenario, the population is predicted to increase by about 2.3% each year, while in the WI scenario, it will increase by about 5% per year.

Table 25: Predicted growth of the backyard desi chicken population, 2020–21 to 2035–36

Breed type	Population			
	Base year 2020–21	2025–26	2030–31	2035–36
Backyard desi chicken BAU	1,57,48,983	1,76,28,125	1,97,31,482	2,20,85,809
Backyard desi chicken WI	1,57,48,983	2,01,00,137	2,56,53,434	3,27,41,005

5.1.1.1 Feed and feeding interventions

- Scavenging chickens can be supplemented with locally available feeds up to 15% of their daily requirement.
- Traps can be used to catch insects to feed to BYP as a protein supplement. Traps are small pieces of equipment, either glue-/water-based or solar light-based, and trap insects such as mosquitos, flies and moths. Another option is to put food waste in a trap to attract insects.
- The larval stage of black soldier fly could be used as a source of protein for BYP and possibly for commercial poultry.

5.1.1.2 Genetic improvement interventions

- Initiate community-based chicken breed improvement programs and train farmers to select the best chickens.
- State government research centres should conserve and selectively breed desi chickens and distribute improved desi chickens to farmers.

- Reproductive wastage should be reduced through the introduction of brooding and artificial incubation facilities such as hay box brooders and small-scale incubators.

5.1.1.3 Health interventions

- Chickens should be vaccinated against priority diseases such as Ranikhet disease (Newcastle disease), fowl pox, etc.
- Currently a negligible percentage of village chickens are vaccinated against diseases like Ranikhet and fowl pox. The aim is to increase the percentage of birds vaccinated against these diseases to 25% by 2025–26, 50% by 2030–31 and 80% by 2035–36.
- Coverage of chicken disease surveillance, diagnostics and reporting should be strengthened.
- Prani Mitras and private chicken veterinary and extension service providers should be promoted.
- The efficiency of public and private veterinary services will be improved by opening veterinary pharmacies at block level for access to much-needed medication.

5.1.1.4 Extension interventions

- The coverage of intensive training for farmers on husbandry of desi chickens (feeding, breeding, housing and management) will reach 50% in the first five years and 80% in the following 10 years.
- A centre of excellence for poultry should be established to serve as a research centre for strengthening the poultry sector. The centre should also have a technology transfer station and a high-level poultry training centre (offering certificate and diploma courses).

5.1.1.5 Marketing and processing interventions

- Promote hygienic chicken slaughter facilities.
- Create spaces for exclusive meat markets in blocks and have weekly markets allowing farmers to trade their produce.
- Educate poultry producers on biosecurity and good hygiene measures for food safety purposes when they slaughter birds for their own consumption or for selling commercially.
- Involve women in producer groups and district-level poultry producer associations to realize better prices for their birds.
- Establish a niche brand for promoting organic desi chickens, especially catering to urban consumers through supermarket chains.
- Kalinga could be the brand for promoting backyard chicken eggs and native chickens.

5.1.2 Bird- and flock-level assumptions and targets for the BYP sector

The following benefits and costs will arise through adopting the village desi chicken improvement interventions.

- Desi chicken flock sizes will rise from the current 2.5 hens to 4 hens in the next 10 years.
- The number of eggs laid per hen per year will increase from the current 66 eggs to about 70 eggs/hen per year.
- Scavenging chickens will be supplemented by 15% of their daily feed requirement with locally available feed resources.

- Chickens will receive supplemental feeding with insects caught in insect traps. One insect trap will cost about INR 1,000. A 50% subsidy is recommended to increase the adoption rate of the technology.
- Desi chickens will be vaccinated against priority chicken diseases (Ranikhet disease and fowl pox).
- Chicken mortality before marketing will drop by about 40–50%.
- Farmers will incur additional costs of INR 2 per bird for vaccination (see Annexe, Table 38) and INR 500 for an insect trap.
- A 10% increase in household consumption of chicken and a 10% increase in household consumption of eggs will significantly impact the health of people, especially women and children.
- The income per hen will increase from INR 4,625 to INR 5,995.

5.2 Scaling up backyard crossbreed chicken (non-incubating) production

5.2.1 Interventions and targets at the state level

Currently, the average flock size in the non-incubating backyard chicken production system is about 20 birds. Due to the semi-scavenging nature of the chickens, increasing the average flock size in the future is not recommended. However, there is the potential to increase the number of birds at the state level to enable more egg production for sale and consumption in rural households.

The aim is to increase the backyard crossbreed chicken population in the state by 6% every five years from the current 3.9 lakh to 5.3 lakh by 2025–26, 7.1 lakh by 2030–31 and 9.5 lakh by 2035–36 (Table 26).

Table 26: Predicted growth of the backyard crossbreed chicken population under the WI scenario, 2020–21 to 2035–36

Breed type	Population			
	Base year 2020–21	2025–26	2030–31	2035–36
Backyard crossbreed (non-incubating)	3,96,489	5,30,592	7,10,051	9,50,209

5.3 Scaling up commercial/specialized chicken production

Scaling up commercial/specialized chicken production can be practised all over the state, particularly in the livestock production zones (hilly and mountain, northwest and coastal plain).

5.3.1 Interventions and targets at the state level

A feed assessment found that the commercial chicken and pig populations in Odisha currently consume about 34% of the total maize, sorghum and wheat produced in the state (see Annexe, Table 40). At present, 55% of maize and 70% of soybean produced at the national level are used as poultry and pig feed. Experts consulted during a result validation study recommended that up to 40% of the total maize produced can be used for chicken and pig rearing. Consequently, the commercial chicken population in the state can be increased safely over the coming three years. However, the state needs to import or produce maize in a new large-scale farm if the state has to satisfy the expected chicken feed demand increase due to the targeted increase in the chicken population.

Therefore, additional land/fallow land should be acquired that can be used to grow maize and soybean during rabi (winter).

- Increasing the number of commercial layer and broiler chickens and farms should be one of the priority targets to meet chicken meat and egg demand in the state.
- The already implemented 40% subsidy scheme for capital investments by layer and broiler farms that invest greater than INR 50 lakh is accelerating the growth of the commercial chicken sector. The scheme needs to continue to maintain the momentum.
- Under the WI scenario, the layer population will grow from the current 86 lakh to 1.5 crore by 2025–26, 2.7 crore by 2030–31 and 4.8 crore by 2035–36 (Table 27).
- Under the WI scenario, the broiler population will grow from the current 60 lakh to 96 lakh by 2025–26, 1.6 crore by 2030–31 and 2.5 crore by 2035–36 (Table 27).
- The layer and broiler chicken populations are projected to grow slightly more rapidly under the WI scenario than under the BAU scenario, i.e. 12% for layers and 10% for broilers every five years (Table 27).

Table 27: Predicted growth of commercial layer and broiler populations, 2020–21 to 2035–36

	Breed type	Population						
		020–21	2025–26	Percentage change first 5 years	2030–31	Percentage change second 5 years	2035–36	Percentage change third 5 years
BAU	Layers	86,87,000	1,39,90,501	10%	2,25,31,842	10%	3,62,87,756	10%
	Broilers (per cycle)	60,00,000	84,15,311	7%	1,18,02,909	7%	1,65,54,190	7%
WI	Layers	86,87,000	1,53,77,931	12%	2,72,22,372	12%	4,81,89,678	12%
	Broilers (per cycle)	60,00,000	96,63,060	10%	1,55,62,456	10%	2,50,63,490	10%

Large parent stock farms and hatcheries for day-old chicks (DOC) will need to be established to satisfy the growing demand for DOC.

- The total number of layer DOC required will reach about 7 crore by 2025–26, 10 crore by 2030–31 and 14.3 crore by 2035–36 (Table 28). To meet this huge demand, five additional DOC production centres will be needed in the first five years, 10 in the second five years and 20 in the third five years of the 15-year livestock strategy.

Table 28: Indicative numbers of day-old chicks required by the end of the first (2025–26), second (2030–31) and third (2035–36) five years of the 15-year livestock strategy

Breed type	Annual number of day-old chicks required			
	Base year 2020–21	2025–26	2030–31	2035–36
Layers[11]	57,91,334	1,02,06,309	1,79,87,003	3,16,99,245
Broilers[12]	4,32,00,002	6,95,74,036	11,20,49,680	18,04,57,130
Total	4,89,91,336	7,97,80,344	13,00,36,683	21,21,56,375

11. To do the DOC estimates for layers, the total population of layers in the 5th, 10th, and 15th years and the production cycle per year of about 0.7 cycles/year was used

12. To do the DOC estimates for broilers, the total population of broilers in the 5th, 10th, and 15th years and the production cycle per year of about 7.2 cycles/year was used

5.3.1.1 Feed and feeding interventions

- Encourage the production of processed chicken feed.
- The total demand for chicken feed is projected to reach about 6.6 lakh MT by 2025–26, 11.2 lakh MT by 2030–31 and 19.3 lakh MT by 2035–36 (Table 29).
- To meet this increased demand, four additional commercial feed processing plants will be required by 2025–26, with six further plants needed by 2030–31 and about six more by 2035–36. Also, farmers should be encouraged to produce their own processed feed in small plants that cost up to INR 5–6 lakh to establish and can process up to 50 tonnes of feed.
- Improve quality assurance of processed feeds for commercial chickens. Strengthen the single existing feed quality control laboratory by 2025–26 and establish three additional public funded laboratories (one per production zone) and three private funded laboratories in the first five years of the livestock strategy. And encourage private sector to establish 10 new laboratories as part of the feed processing plant in the second 5 years.

Table 29: Indicative estimates of demand for processed/commercial feed

Breed type	Annual feed demand (MT)		
	2025–26	2030–31	2035–36
Layers[13]	4,43,974	7,82,435	13,78,917
Broilers[14]	2,12,587	3,42,374	5,51,397
Total feed required	6,56,562	11,24,809	19,30,314

- Make land available to produce additional cereals (maize) and soybean for the production of processed feed. Encourage private investors to engage in maize and soybean production.
- The additional land that needs to be allocated for maize and soybean production should reach 5.4 lakh ha by 2025–26, about 21.0 lakh ha by 2030–31 and 4,5.3 lakh ha by 2035–36 (Table 30). A government subsidy scheme is recommended to ensure the production of these crops during rabi (winter). An INR 2,000 subsidy per hectare is suggested for farmers cultivating maize and soybean during rabi (winter).

Table 30: Indicative estimates of additional land required to produce maize and soybean[15]

Crop	Additional land required (ha)		
	2025–26	2030–31	2035–36
Maize[16]	25,951	1,01,313	2,19,059
Soybean[17]	27,739	1,08,296	2,34,158
Total land	53,690	2,09,609	4,53,217

5.3.1.2 Marketing and processing interventions

- Strengthen poultry producers' associations and increase the number of market outlets.
- Promote hygienic chicken slaughter facilities by offering an incentive of INR 1,000 per store per quarter to all meat markets and registering them under the Food Safety and Standards Authority of India (FSSAI). The aim is to cover about 2,000 outlets per year, and 30,000 outlets over the next 15 years.

13. 29kg of average annual feed consumption per a layer bird was used, own calculation
14. 22kg of average annual feed consumption per broiler bird was used, own calculation
15. It should be noted that it is possible to use different ration formulations that can alter the additional land size proposed here
16. Current productivity of maize in Odisha is about 2,993kg/ha (source: Odisha Agriculture Statistics 2018-19); 70% maize in the chicken feed is considered
17. Current productivity of soybean in Odisha is about 1,200kg/ha; 30% of soybean ration in chicken feed is considered

- A total of five modern chicken slaughter and processing plants will be established to process chicken meat. One unit will be for organic chicken and four units will be for regular chicken processing.
- Include eggs in the mid-day meal program to promote better nutrition for women and children. About 4 crore eggs per year will be required through the Child and Women Welfare Department.
- Develop social marketing and online delivery platforms to promote chicken and egg consumption.
- Private integrators will be engaged to provide DOC and help farmers with the necessary inputs. Each integrator will work with 125 farms every five years. Currently, five integrators are working in the state.

5.4 Impact of interventions

5.4.1 Projected population

With additional investment, the total chicken population in Odisha State will grow to 1,069 lakh with a 247% increase in the next 15 years (Table 31). About 68% of the total increase, however, is coming from the commercial/specialized system (both layers and broilers). With additional intervention, the projection for 2035–36 shows a 455% and 318% increase in the populations of layers and broilers, respectively.

Table 31: Comparison of current (2020–21) and BAU and WI projected (2035–36) chicken population in total and by production subsystem

Chicken production subsystem	Population (lakh)				
	Base year 2020–21	BAU 2035–36	Percentage change from base under BAU	WI 2035–36	Percentage change from base under WI
Backyard desi	157.5	220.9	40%	327.4	108%
Backyard crossbreed	4.0	8.4	112%	9.5	140%
Layers	86.9	362.9	318%	481.9	455%
Broilers (per cycle)	60.0	165.5	176%	250.6	318%
Total	308.3	757.7	146%	1,069.4	247%

Source: LSS results

5.4.2 Projected production

As a result of investment interventions, total chicken meat production would increase by 317% between 2020–21 and 2035–36, in contrast to 136% in the same time horizon under BAU (Table 32). Compared to the base year, chicken meat production would increase from 1,03,119 MT to 2,43,587 MT under BAU and to 4,29,769 MT under the WI scenario. In the WI scenario, the meat gain from broilers accounts for about 67% of the total meat gain by 2035–36.

As a result of the interventions, total egg production would increase from 217 crore in 2020–21 to 1,135 crore in 2035–36. Most of this additional production would come from commercial layers. However, the increase in production from village backyard or traditional family poultry is also substantial and, over the 15 years, would be 124% in contrast to 40% achieved under BAU.

Table 32: Comparison of current (2020–21) and BAU and WI projected (2035–36) chicken production

Products	Production				
	Base year 2020–21	BAU 2035–36	Percentage change from base under BAU	WI 2035–36	Percentage change from base under WI
Chicken meat by chicken subsystems (MT)					
Backyard desi	44,038	72,704	65%	1,07,123	143%
Backyard crossbreed	378	800	112%	905	140%
Layers	5,724	23,910	318%	31,752	455%
Broilers	52,980	1,46,173	176%	2,89,988	447%
Total chicken meat (MT)	1,03,119	2,43,587	136%	4,29,769	317%
Egg production by chicken subsystems (crore)					
Backyard desi	14	20	40%	32	124%
Backyard crossbreed	3	6.4	113%	7.2	140%
Layers	197	825.	318%	1,096	455%
Total eggs (crore)	217	851	292%	1,135	424%
Total manure ('lakh MT)	2.33	11.92	412%	17.46	649%

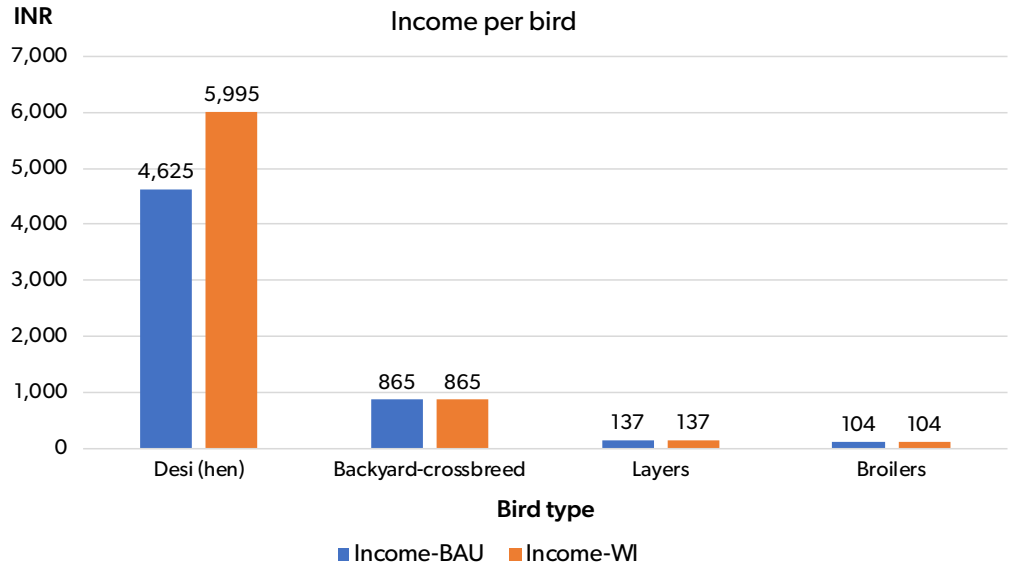
Source: LSS results

5.4.3 Projected annual income per animal

Figure 6 presents the projected income per animal for the BAU and WI scenarios. The annual income per animal in the village BYP system reflects income per hen with eight followers. The income per hen is approximately INR 4,625 and INR 5,995 under the BAU and WI scenarios, respectively.

The income per animal in the village crossbreed chicken system is lower, about INR 865 per animal in both scenarios. Similarly, there is not much difference in income per animal observed under the BAU and WI scenarios for the specialized chicken systems. Most of the income in the specialized systems will depend on the size of the farms.

Figure 6: Projected average annual income (INR) per chicken in the BAU and WI scenarios.



Source: LSS results

5.4.4 Return on investment in all poultry systems

The results of investment analysis for chicken production are summarized in Table 33. The investment accounts for a school mid-day egg meal investment (the alternative investment without a school mid-day egg meal is presented in the Annexe, Table 44). The financial indicators based on the 15-year discounted incremental cash flow analysis indicate that the investment in the backyard and commercial production systems is financially viable. The results indicate that IRR in BYP is higher than in the commercial poultry sector.

Table 33: Farm-level NPV and IRR evaluation for chicken production in Odisha in 2035–36 under the WI scenario

Poultry production size/flock	Flock size	Financial indicators based on 15-year discounted incremental cash flow analysis	
		NPV (thousand INR)	IRR (%)
Backyard desi	4	81.0	#NUM!
Backyard crossbreed	20	1.5	33%
Layer	54,000	2,364.1	33%
Broiler (per cycle)	2,500	225.8	55%

Source: LSS results; #NUM! – Very large and not calculated

5.4.5 GSDP contribution of the poultry sector

As shown in Table 34, by 2035–36 under the WI scenario, the GSDP contribution of the poultry sector is extremely high, almost twice what would be achieved in the same time horizon under the BAU scenario. By 2035–36, with the proposed interventions scenario, the GSDP contributions of the poultry sector grow by 239% to INR 6,170.8 crore compared to only INR 3,400 crore under the BAU scenario. More than 86% of the GSDP is contributed through chicken meat production by both village BYP and specialized broilers and layers.

Table 34: GSDP contribution of poultry sector for 2020–21 and 2035–36 under BAU and WI scenarios

Products	GSDP (crore INR)				
	Base year 2020–21	BAU 2035–36	Percentage change from base under BAU	WI 2035–36	Percentage change from base under WI
Chicken meat by chicken subsystems					
Backyard desi	1,436.8	2,372.0	65%	4,624.9	222%
Backyard crossbreed	5.0	10.6	112%	12.0	140%
Layers	40.2	168.0	318%	223.1	455%
Broiler	82.7	228.1	176%	452.6	447%
Total chicken meat	1,564.7	2,778.8	78%	5,312.6	240%
Egg production by chicken subsystems					
Backyard desi	139.9	196.1	40%	310.0	122%
Backyard crossbreed	11.08	23.47	112%	26.5	139%
Layers	76.0	317.6	318%	421.8	455%
Total eggs	234.4	552.7	136%	758.3	224%
Total manure	20.5	69.1	237%	99.9	387%
Total chicken sector	1,819.6	3,400.6	87%	6,170.8	239%

Source: LSS results

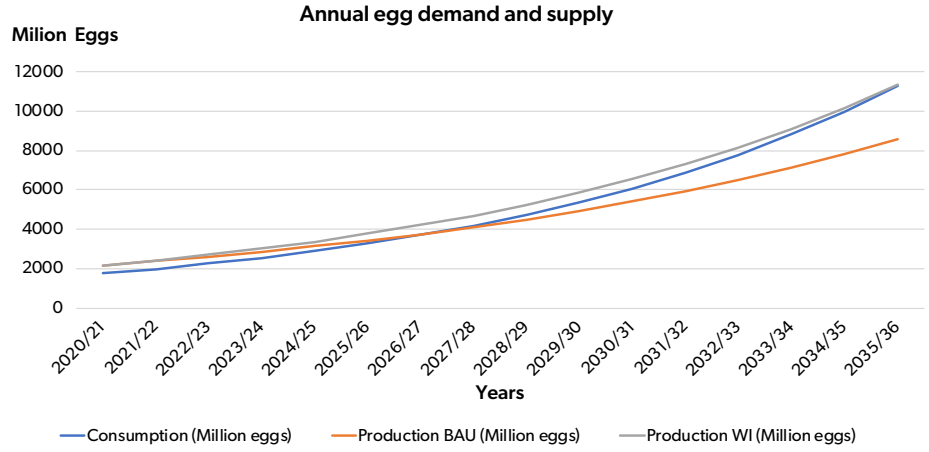
The production and GSDP contribution results reveal that a great deal can be obtained from the investment in village BYP and specialized broilers and layers. The incremental benefit from the commercial/specialized system is exceptionally high and certainly justifies investment. This is good news for private investors, but investment in the sector needs to be encouraged through policy incentives and technological and extension support.

5.4.6 Poultry sector production-consumption balance

5.4.6.1 Eggs

Figure 7 shows the projected production and consumption of eggs under the BAU and WI scenarios. Egg demand in Odisha State is projected to steadily increase from 170 crore eggs per year in 2020–21 to 1,120 crore eggs per year in 2035–36, an increase of 543%. The figure shows that under BAU, egg production is expected to increase by 291% over 15 years, and egg production will slightly exceed consumption until 2027–28. Egg demand is then projected to exceed supply due to changes in population, urbanization and income. Meanwhile, under the WI scenario, egg production will increase by 425% from 2020–21 to 2035–36. With additional investment in egg production, the state is expected to stay self-sufficient and possibly be a net exporter of its small excess egg production to neighbouring states.

Figure 7: Future production-consumption balance for eggs under BAU and WI.

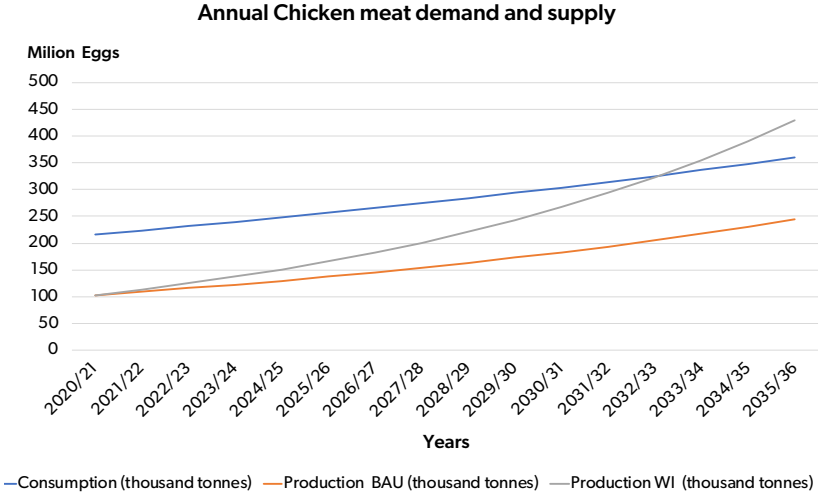


Source: LSS results

5.4.6.2 Chicken meat

The future chicken meat production-consumption balance under the BAU and WI scenarios is presented in Figure 8. Chicken meat consumption in Odisha is projected to increase by 67% between 2020–21 and 2035–36. The LSS scenario analysis for chicken meat investment shows that, with production improvement interventions, it will be possible for the production to meet potential consumption around 2032-33. With the additional chicken production improvement interventions targeted at increasing the population of broilers and quantity of poultry feed, chicken meat production is projected to increase by about 317% over the 15-year horizon.

Figure 8: Future production-consumption balance for chicken meat under BAU and WI.



Source: LSS results

5.4.7 Gender and social inclusion implications for poultry value chain development

Poultry farming is an important source of livelihood for the rural poor in Odisha, specifically for women in marginalized communities. They have traditionally been rearing BYP (desi birds), since these are required for various socioreligious ceremonies (Banja et al. 2017). BYP farming has significant advantages over other livestock activities as it can be conducted under diverse agroclimatic conditions, requires low capital investment and can provide quick returns and continuous income throughout the year to women who rear the birds[18]. Poultry are among the few assets that a female farmer owns and has decision-making power for in terms of sales and use of the income accrued.

Presently, there is a need to acknowledge that desi birds and LIT birds are two distinct production systems. While desi BYP are reared traditionally, LIT birds are being introduced through various government schemes, making poultry farmers dependent on inputs like DOC, feed, vaccines, etc. Economic analysis suggests that BYP rearing is more lucrative than LIT birds from a livelihood enhancement perspective. However, since LIT birds provide a good number of eggs compared to desi birds, promoting LIT birds can be an excellent way to enhance access to micronutrients and protein-rich foods, especially for combating malnutrition in children and anaemia in women.

It is recommended that DAH & VS employs dedicated gender-sensitized staff for carrying out extension activities related to BYP. Village-level service providers, i.e. Prani Mitras, can be trained for this purpose and can also administer vaccinations and dewormers through a sustainable business model with private sector engagement in vaccine supply. The services of the Prani Mitra should be paid for by female farmers. A memorandum of understanding has been signed with Odisha Livelihood Mission (OLM) to ensure the Prani Mitra program runs aligned with FARD Directorate objectives. Moreover, supporting female Prani Mitras as service providers will increase employment avenues for rural women and offer role models for young girls.

There should also be investment in low-cost hatcheries for BYP chick production at the community level through women's self-help groups/rural unemployed youth schemes and in training women and youth to run these hatcheries efficiently.

[18] Study on small ruminant and poultry chain -Aajeevika

6 Conclusions and recommendations

Like many Indian states, the livestock sector is very significant to the economic development of the State of Odisha. The sector contributed around 3% to GSDP in 2020–21 and significantly impacts poverty reduction by employing many people. The livestock sector serves as a source of income generation for most of the farmers in Odisha, where about 85% of the livestock population is owned by landless people and marginal and small landholders. Among rural female workers in Odisha, 87% are employed in agriculture as labourers and cultivators, and the majority keep livestock in their backyards. As most rural communities depend on livestock for their livelihoods, the development of the sector, especially in the most marginal areas, is extremely important in meeting the need for livestock products both at individual and state levels. Given the very high involvement of women in livestock production, gender-sensitive policies could significantly increase the productivity of animals and impact the overall production of the state. Any interventions and policies related to BYP and goats should prioritize women and address their constraints, needs, capabilities and aspirations if such interventions are to achieve successful outcomes.

Most farmers are unable to capitalize on the opportunities existing in the livestock sector, making the sector underexploited. Existing livestock farmers face myriad challenges, ranging from feeding and feed resource management to disease dynamics, marketing and credit access, among others, which hinder the achievement of objectives in the sector. Given the importance of the sector to the economy of Odisha, pragmatic steps, such as the creation of strategies and relevant investments, are needed to develop the livestock sector and generate the necessary gains for individuals, the State of Odisha and the nation.

This Livestock Sector Strategy (LSS) presents a plan to guide investments in the livestock sector, helping it to modernize further and make an even more substantial contribution to state development goals. It provides quantitative evidence that justifies the investments required to meet future potential demand for livestock products. It presents projections for the different LVCs based on scenario analysis of returns on investments in different areas, combined with technology and policy interventions. It can provide guidance to state policymakers for planning and supporting much-needed investments from public and private sources. The LSS presents various interventions to improve the dairy value chain, small ruminant value chain and the poultry value chain. The interventions aim to improve genetics, animal feed, animal health and extension service delivery, marketing and processing, and livestock research. The foresight analysis presented in this LSS considers an intervention scenario where various livestock interventions are presented and tested to predict whether they will help meet future demand for milk, meat and eggs.

6.1 Livestock production systems

The main livestock production systems practised in Odisha vary across the coastal plain, hilly and mountain, and northwest production zones. The coastal plain system is characterized by improved cattle breeds, whereas small ruminants and poultry dominate in the northwest and hilly and mountain zones. The coastal plain production system practises stall feeding only. Thanks to the availability of large forest areas and grazing lands, the hilly

and mountain zone practises grazing only, and the northwest zone practises both grazing and stall feeding. The market infrastructure in the coastal plain zone is well-developed, with better market access than in the other two production systems.

There is also a commercial/specialized livestock production system that extends across all three production zones. This system comprises urban and periurban dairy and layer and broiler poultry systems that are distinct from the traditional, family-based livestock production system.

6.2 Constraints and challenges in the livestock sector

Like many other states, Odisha faces several challenges in its livestock sector despite its growth over the years. The livestock sector's major constraint is the lack of feed and knowledge of animal feeding. The shortage of feed, caused mainly by insufficient land, water scarcity and the inability of farmers to adopt proper feeding mechanisms, has resulted in underexploitation of the potential of the livestock sector in Odisha. The general lack of support for and knowledge of fodder cultivation, and the nonexistence of a fodder market, are hampering livestock production.

Another major challenge facing the sector is the prevalence of diseases such as FMD, mastitis, brucellosis, HS, BQ, theileriosis and IBR, among others. Insufficient veterinary institutions and provision of veterinary services direct to farmers, means the situation has become precarious, particularly for female farmers. The sector is also challenged by the lack of access to breeding services and the low productivity of local breeds despite efforts to improve production, especially in cattle, through AI. In addition, the livestock sector is characterized by poor infrastructure, resulting in a lack of market access. Inadequate market information, coupled with exploitation of producers by intermediaries and a general absence of producer groups, has hampered the growth of the livestock sector. Access to support services such as extension and training and curative and preventive animal health services is lacking. As a result, women, who currently dominate small ruminant and backyard chicken production, are impacted the most, limiting their potential in the livestock sector.

A few critical enablers for gender equity and the empowerment of women include:

- Improving coverage of livestock extension. Focus on all livestock species and reach out to women and marginalized communities. In conjunction, provide training to women's groups at venues that are closer to their homes and offer childcare for children and separate bathrooms. ICT can strengthen the linkage between extension, research and farmers, and AHD needs to invest in developing appropriate communication and training material to make use of ICT tools (smartphones, cell phones, radio, TV, internet) in offering extension and advisory services to female farmers.
- Increasing access to animal health and breed improvement technologies. Invest in Prani Mitras (and Pashu Sakhis) to ensure vaccinations and deworming are locally available to farmers; raise awareness of zoonoses, biosecurity and food safety (e.g. TB, brucellosis); provide training in the hygienic handling of milk; develop slaughter points with wastewater and offal management in village haats (to be run by youth); train youth and women as AI technicians; initiate breed conservation programs with the active involvement of female farmers; and provide good quality breeding bucks.

6.3 Dairy value chain improvement strategies

Despite the numerous interventions implemented by the State of Odisha in the dairy sector, milk productivity remains low compared to the national average and neighbouring states. Research into and improvement of the sector's constraints are central to greater productivity among dairy animals. Additional investments for improving animal feed, breeding and health are critical.

6.4 Small ruminant value chain improvement strategies

There is potential for smallholders to improve their livelihoods thanks to population growth, urbanization, increasing incomes and rising demand for sheep and goat meat in Odisha. Despite this huge potential, constraints such as the lack of health care facilities, insufficient feed, high mortality and exploitation by intermediaries during marketing, among others, are hindering improvement of the sector. Holistic and comprehensive strategies need to be adopted in the areas of animal health, feeding and feed resources, animal breeding/genetic improvement, extension service delivery, research, and marketing and processing.

6.5 Poultry value chain improvement strategies

The poultry value chain has evolved over the years. It is important to create awareness of feed balance, promote supplementation in feeds and supplement scavenging chickens with up to 15% of their daily requirement using locally available feeds. It is also necessary to intensify vaccination and deworming of birds, educate female producers on biosecurity and involve women in producer groups.

6.6 Impact of no intervention (BAU-scenario)

In the absence of major interventions in the livestock sector, projections under a BAU scenario over 15 years show a general reduction in the population of all livestock species except for crossbreed cattle and chickens in 2035–36 compared with the population in the base year of 2020–21.

The analysis reveals that projected egg production will increase from 170 crore eggs in 2020–21 to 820 crore eggs in 2035–36 in the BAU scenario, an increase of 382%. However, consumption will increase from 210 crore eggs in 2020–21 to 1,120 crore eggs in 2035–36, a 433% increase. In the initial phase up to 2025–26, production will be slightly higher than consumption but after 2025–26 consumption will outstrip production due to population growth and income changes.

The demand for milk and milk products is projected to increase by 8.3% annually under the BAU scenario, with production projected to increase by 2% annually. Similarly, both chicken consumption and production are expected to increase in a BAU scenario, but without investment production will fulfil only 59% of consumption demand by 2035–36. Goat and sheep meat consumption are projected to grow within the same period, though production is expected to decrease, meeting only 17% and 3% of demand for goat meat and sheep meat, respectively.

6.7 Impact of intervention (with-intervention scenario)

6.7.1 Dairy

A greater increase in the population of crossbreed dairy cattle is projected for all three production zones under the WI scenario than the BAU scenario. For example, in the coastal plain zone, the dairy cattle population is projected to increase by 115% in the WI scenario by 2035–36 compared to 45% in the BAU scenario. The total population of crossbreed cattle is projected to increase by 112% between 2020–21 and 2035–36 in the WI scenario, compared to a 46% increase in a BAU scenario. The number of traditional dairy breed cattle is projected to decrease by 25% under the WI scenario compared to an 11% decrease in the BAU scenario.

Milk production by indigenous breeds is projected to increase by 35% over the 15 years in the WI scenario compared to a 13% reduction in the BAU scenario. Milk production by crossbreeds and commercial dairy breeds is projected to increase by 177% and 131%, respectively, for the WI scenario compared to projected increases of 45% and 119%, respectively, under the BAU scenario.

6.7.2 Small ruminants

The proposed interventions in small ruminant production are expected to increase individual animal and herd productivity. This will lead to significantly increased production and quality of meat to meet the local demand while increasing the incomes and livelihoods of small ruminant farmers. At both community and state levels, huge investment is needed to ensure a well-functioning value chain that will increase farmer incomes while meeting state and national development goals, and increase contributions to GDP through exports.

Interventions in improved feeding and management practices, animal health improvement, breeding, extension services, research and development, among others, are necessary to achieve a well-functioning small ruminant market. The LSS results show that further investments in the development of the small ruminant sector will increase goat meat production from 32,223 MT in 2020–21 to 61,312 MT in 2035–36 compared to 31,703 MT in a BAU scenario. Goat milk production is projected to increase from 6.2 to 10.6 lakh litres between 2020–21 and 2035–36 in the WI scenario compared to decreasing to 6.1 lakh litres under BAU. With interventions, the average live weight of goats when sold will increase from 18.1 kg to 19.8 kg over the same period.

With regard to sheep, the LSS results show that the sheep population in Odisha will increase by 76% by 2035–36 in the WI scenario but decrease by 10% in a BAU scenario. The results further show that the coastal plain zone will witness the highest increase (97%), followed by the hilly and mountain zone (88%). The sheep population will increase the least in the northwest zone (46%). Generally, households with fewer than 10 sheep will experience a greater increase (80%) than farm households with more than 10 sheep (67%).

On average, total sheep production under the WI scenario will increase by 76% compared to a projected decrease of 12% under BAU. Specifically, sheep meat production is projected to increase by 92% (from 5,612 MT in 2020–21 to 10,786 MT in 2035–36) in the WI scenario, but will decrease by 10% (from 5,612 MT in 2020–21 to 5,024 MT in 2035–36) in the BAU scenario. The average live weight of sheep will increase by 8% (from 20.3 kg in 2020–21 to 22.0 kg in 2035–36).

The LSS results further show that goat and sheep meat consumption in Odisha State is expected to increase by about 147% over the 15-year period. The quantity of goat and sheep meat produced over the same period is expected to increase by 67% in the BAU scenario and by 185% with additional investment in goat improvement interventions. The projected impact of additional interventions on closing the existing gap between goat and sheep meat produced and consumed is not significant over the 15-year investment period, and the supply shortage will continue under either the BAU or WI scenarios.

6.7.3 Poultry

Under the WI scenario, the backyard crossbreed chicken population in the state is projected to increase from the current 3.9 lakh to 5.3 lakh by 2025–26, 7.1 lakh by 2030–31 and 9.5 lakh by 2035–36, representing 6% growth in each five-year period. This will benefit women and other vulnerable groups who are particularly engaged in traditional backyard chicken production.

The layer and broiler populations are projected to grow by 10% and 12%, respectively, every year in the WI scenario compared to 10% and 7% under the BAU scenario. Overall, the populations of layers and broilers are projected to increase by 455% and 318%, respectively, by 2035–36. This reveals that there is an urgent need to put in measures that will ensure that the demand for DOCs is met to achieve this production projection. The range

of strategies that can meet this demand includes practising good feeding mechanisms, strengthening poultry producer associations and increasing the number of market outlets, among others. Since feeding is important in both layer and broiler production, commercial feed processing plants need to be established across the state to meet the demand for balanced feed.

6.7.4 Profitability impacts and GSDP

6.7.4.1 Income per animal

The results of the LSS analysis show that projected income per animal in 15 years in the dairy sector will be significantly more under the WI scenario than the BAU scenario for all three cow types.

Similarly, in the coastal plain zone, the income per animal for small and large goat herds will increase to INR 3,440 and INR 3,387, respectively, under the WI scenario, compared to INR 3,363 and INR 3,274, respectively, under the BAU scenario. In the northwest zone, the projected income per animal for the WI scenario will be INR 3,031 and INR 2,935 for small and large goat herds, respectively, compared to INR 2,919 and INR 2,762, respectively, under the BAU scenario. The projected income per animal in the hilly and mountain zone is lower than the other two zones, at INR 2,732 and INR 2,656 for small and large goat herds, respectively, for the WI scenario.

The projected income per animal for sheep in the coastal plain zone will be higher, at INR 3,200 for small sheep flocks, under the WI scenario compared to INR 2,979 for the BAU scenario.

The annual income per animal in village BYP systems is projected to increase as a result of additional interventions. This will have positive livelihood and nutrition outcomes for women who rear them. Income in commercial/ specialized chicken systems will mainly depend on the size of the farms, while it is projected to be lower for LIT chicken.

6.7.4.2 Profitability

The NPV and IRR values for all the interventions are adequately attractive to warrant investment in the livestock sector. In the case of dairy, the returns on investments measured by the NPV and IRR are higher for crossbreed dairy cows than indigenous cows across all three production zones. Despite the low investment potential compared to crossbreed cows, investments in indigenous cattle will still yield marginally attractive revenues. Commercial dairy farmers that own small herds will have a higher IRR than large commercial dairy farmers. Strategic investments in indigenous dairy, aside from the financial benefits presented to farmers, will have additional benefits that are projected to improve the value chain, especially for women and socially disadvantaged groups,

The results of the LSS show that it is very profitable to invest in small ruminant production. Large-scale goat farms are projected to achieve an IRR of 38% in the northwest zone and 36% in the coastal plain zone. The IRR for both small and large sheep flocks in the coastal plain zone is 44%.

6.7.4.3 GSDP

The contributions of all the value chains in the livestock sector to both state income and GSDP are significant and positive. In particular, with specific interventions in the dairy sector, the contribution of milk production from indigenous, crossbreed and commercial dairy cows to GSDP will increase by I88%, 179% and 130%, respectively, over the 15-year period. Total milk production is projected to increase by 162% for the same period. The contribution of goats and sheep to GSDP, though not as significant as that of other livestock products, is still important to the economy of Odisha. With additional investment in goat production, the contribution of goat meat to GSDP will increase from INR 1,859 crore in 2020–21 to INR 3,385 crore in 2035–

36, an increase of 82%; under the BAU scenario, the contribution would decrease by 2% to INR 1,822 crore by 2035–36. In the case of sheep, the projected total meat GSDP contribution will increase by 82% in the WI scenario, but fall by 11% in the BAU scenario between 2020–21 and 2035–36.

The LSS results also show that it is profitable to invest in improvements in all poultry types and production zones. When specific interventions are made in the chicken value chain, the contribution of chicken meat and eggs to GSDP will be increased for all the different chicken types compared to the BAU scenario. The incremental benefit from the commercial/specialized systems is projected to be extremely high, which justifies investment in both broiler and layer production.

6.7.5 Investment impacts on future production and potential consumption

To assess the ability of the livestock sector in Odisha to meet potential supply gaps, the LSS made projections concerning future production and potential consumption under a BAU scenario with no intervention and a WI scenario involving policy and technological interventions.

With increasing population and urbanization resulting in changes in consumer preferences, demand for livestock products will be impacted significantly, making strategic investment in the sector imperative. Knowledge of future trends is important to guide the magnitude of investment in the livestock production interventions that will be required to address any differences between production and projected consumption.

Both projected milk demand and production are anticipated to increase annually by 8.3% and 2%, respectively, under the BAU scenario between 2020–21 and 2035–36. Projected production is larger than projected consumption in 2020–21, a pattern that is expected to continue for the first five to six years, after which projected milk consumption will exceed projected production With additional investment in the dairy sector, particularly in feeding, it is expected that milk production will increase significantly, aligning it more closely with projected consumption.

The demand for eggs is projected to increase significantly (by 543%) over the 15-year period. Egg production is projected to increase by 291% in a BAU scenario compared to a 425% increase in an intervention scenario. It is expected that any additional investment in egg production will facilitate self-sufficiency in egg production, which could generate income for the state through the export of surplus eggs.

In the case of chicken meat, the projected consumption will increase by 67% over the 15-year horizon (2020–21 to 2035–36). Additional interventions targeting the broiler population and poultry feed production will increase chicken meat production by about 317% over the 15 years.

Meanwhile, over the same period, the quantity of red meat (both goat and sheep meat) produced is predicted to increase by 90.5% with additional investments and interventions. Due to the projected rapid increase in demand for red meat, however, it will not be possible to align production with potential consumption by 2035–36.

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Annexes

Table 35: Number of semen doses produced at the Cuttack semen production station by cattle breed in 2020–21

Cattle breeds	Semen produced
Jersey	1,06,260
Crossbreed Jersey/Crossbreed Holstein Friesian	2,81,545
Red Sindhi	45,050
Hariana	59,390
Gir	21,200
Binjharpuri	10,485
Tharparkar	1,800
Sahiwal	10,635
Total	5,36,365

Source: Government of Odisha 2021[b]

Table 36: Cost of treatments for cattle

Treatment	Cost per dose (INR)
FMD vaccination	2
HS vaccination	1.5
BQ vaccination	1
External parasite treatments	2
Internal parasite treatments	2

Table 37: Cost of treatments for goats and sheep

Diseases	Cost per dose (INR)
PPR vaccination	1
Goat pox vaccination	1
ET vaccination	1
Anthrax vaccination (endemic areas)	1
FMD vaccination	1
External parasite treatments	1
Internal parasite treatments	1

Note: Including user fee

Table 38: Cost of vaccines for poultry

Disease		Vaccination cost per dose (INR)	
	Dosses per bottle	Government rate (/bottle)	Private (/bottle)
Ranikhet disease (Lasota) (live)	100 doses	15/-	25/-
Infectious bursal disease	100 doses	15/-	25/-
Fowl pox	100 doses	15/-	25/-
R2B	100 doses	15/-	25/-

Table 39: Feed balance assessment results for ruminants in 2020–21

Base year (2020–21)	Total metabolizable energy (MJ)	% resources available
Available feed resources	12,95,88,643	
Feed requirements	19,32,80,941	
BALANCE	–6,36,92,298	67

Table 40: Percentage of cereal production required for feeding chickens and pigs in Odisha

Cereals	Cereal production in 2018–19 in Odisha (MT)	Total cereal equivalent required for chickens and pigs in 2020–21	Percentage of cereal equivalent required for chickens and pigs in relation to the production of maize, millet and sorghum
Wheat	3,940	3,02,047	34%
Jowar	4,560		
Bajra	1,340		
Maize	7,52,570		
Ragi	1,04,920		
S.Millets	16,980		
Total cereals	8,84,310		

Source: Odisha Agriculture Statistics 2018-19

Table 41: Farm-level NPV and IRR evaluation for family and commercial dairy production in Odisha in 2035–36 under the WI scenario without mid-day milk subsidy

Production zone	Breed/size	The new values – no mid-day milk	
		NPV (thousand INR)	IRR (%)
Hilly and mountain	Indigenous breed family dairy	2.7	13%
	Crossbreed family dairy	101.7	43%
Northwest	Indigenous breed family dairy	2.4	13%
	Crossbreed family dairy	99.4	39%
Coastal plain	Indigenous breed family dairy	9.9	20%
	Crossbreed family dairy	230.7	47%
Commercial dairy	Small	544.3	303%
	Large	2,658.3	259%

Table 42: Offtake and population growth rates and average live weight of goats when sold

Parameters	Base year 2020–21	WI 2035–36
Average live weight when sold (kg)	18.1	19.8
Offtake rate (%)	56.5%	55.8%
Population growth rate (%)	–0.12%	3.81%

Table 43: Offtake and population growth rates and average live weight of sheep when sold

Parameters	Base year 2020–21	WI 2035–36	% change
Average live weight when sold (kg)	20.3	22.0	8%
Offtake rate (%)	45.7%	46.1%	0.4%
Population growth rate (%)	–0.74%	3.78%	–614%

Table 44: Flock-level NPV and IRR evaluation for chicken production in Odisha in 2035–36 under the WI scenario without school mid-day egg meal

Poultry production size/flock	New results – no mid-day egg	
	NPV (thousand INR)	IRR (%)
Backyard desi	81.0	#NUM!
Backyard crossbreed	1.61	41%
Layer	2,613.7	42%
Broiler	237.4	68%

Source: LSS results; #NUM! – Very large and not calculated

Table 45: Consultation with State Technical Team (STT) in different periods

Sl. no	Name of member	Designation
1	Premananda Rout	Additional director, Livestock Development, DAH & VS Odisha, Cuttack
2	Gopal Krushna Tripathy	Joint director, VOTI
3	Gopal Charana Bal	Research officer, ADRI, Cuttack
3	Soumyendra Dhal	Deputy director, Poultry, DAH & VS Odisha, Cuttack
4	Partha Sarathi Swain	AVAS, Baranga, Cuttack
5	Samir Das	AVAS, Sumandal, Ganjam
6	Sadasiv Mohapatra	Deputy Director, Balasore

Table 46: Future investment strategies in cattle sector workshop, 8 September 2021

Sl. no	Name of expert	Designation
1	K. V. K. Pattanaik	Retired CEO, OLRDS, Bhubaneswar
2	Gopal Krushna Tripathy	Joint director, VOTI, Bhubaneswar
3	Shri Sukant Kumar Jena	Retired fodder development officer, DAH & VS Odisha
4	Niranjan Panda	Professor, Department of Animal Nutrition, CVSc & AH, OUAT, Bhubaneswar, Odisha
5	Bhagirathi Panigrahi	Professor, Department of Livestock Production and Management, CVSc & AH, OUAT, Bhubaneswar, Odisha
6	Prof C R Pradhan	Retired professor, Department of Livestock Production and Management, OUAT
7	Vijay Bhaskar Reddy	Consultant, ILRI
8	Sanjay Palai	Consultant, ILRI

Table 47: Consultation workshop on livestock investment strategies, 17 September 2021

Sl. no	Name of official	Designation
1	Yeddula Vijay, IAS	Director, DAH & VS Odisha, Cuttack
2	Premananda Rout	Additional director, DAH & VS Odisha
3	P. K. Khamari	Additional director, Plan Human Resource Development (HRD)
4	Lokanath Behera	Additional director, Veterinary Services
5	Gopal Krushna Tripathy	Joint director, VOTI
6	Nityananda Das	Joint director, Livestock Breeding
7	Nigam Nayak	Specialist, OLRDS
8	M Subudhi	CDVO, Cuttack
9	Dipti Mohapatra	Deputy director Small Animal Development
10	Soumyendra Dhal	Deputy director Poultry
11	Gopal Chandra Bal	Research officer (RO), ADRI, Cuttack
12	Partha Sarathi Swain	AVAS, Baranga, Cuttack
13	Samir Das	
14	Sadasiv Mohapatra	Deputy director, Balasore
15	Rajeba Sharma	Officers in special duty (OSD), FARD Department
16	Niranjan Panda	CVSc & AH, OUAT
17	Bhagirathi Panigrahi	CVSc & AH, OUAT
18	D. Karna	CVSc & AH, OUAT
19	A. K. Panda	ICAR-CIWA
20	M. K. Parhi	ICAR-DPR
21	Shri Sukant Kumar Jena	Retired Fodder Development Officer, DAH & VS Odisha
22	J. K. Patnaik	OMFED
23	Vijay Bhaskar Reddy	Consultant, ILRI

Sl. no	Name of official	Designation
24	Pragya Mathur	Samagra Governance
25	Braja Bandhu Swain	ILRI
26	Sanjay Palai	Consultant, ILRI

Table 48: Future investment strategies on poultry, 23 September 2021

Sl. no	Name of expert	Organization
1	Niranjan Panda	Professor & head, Department of Animal Nutrition, CVSc & AH, OUAT, Bhubaneswar
2	Arun Kumar Panda	Principal scientist, ICAR-CIWA
3	Pravat Kumar Sahoo	Retired CDVO, Malkangiri
4	Rudra Narayan Pradhan	Project monitoring unit (PMU), DAH & VS Odisha
5	M. K. Padhi	Principal scientist, Regional Centre, ICAR-DPR, Bhubaneswar
6	Vijay Bhaskar Reddy	Consultant, ILRI
7	Mamata Dhawan	Consultant, ILRI

Table 49: Future investment strategies on goats and sheep, 24–25 September 2021

Sl. no	Name of expert	Designation
1	K. V. K. Patnaik	Retired CEO, OLRDS, Bhubaneswar
2	Rabi Maharatha	Retired additional director, DAH & VS Odisha, Cuttack
3	G. Ch. Mohapatra	Retired CDVO, Jharsuguda
4	D. N. Biswal	Retired joint director, DAH & VS Odisha, Cuttack
5	D. K. Karna	Department of Animal Breeding & Genetics, CVSc & AH, OUAT, Bhubaneswar, Odisha
6	Vijay Bhaskar Reddy	Consultant, ILRI
7	Mamata Dhawan	Consultant, ILRI

Table 50: Consultation workshop on strategies on goat, sheep and dairy, 7 December 2021

Sl. no	Name of official	Designation
1	Gopal Krushna Tripathy	Joint director, VOTI
2	Rajeba Sharma	OSD, FARD Department
3	Niranjan Panda	CVSc & AH, OUAT
4	A. K. Panda	ICAR-CIWA

Table 51: Investment budgets for 15-year dairy improvement intervention

Investment intervention	Investment cost (crore INR)																Budget source
	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	Total	
Total feed investments	12.6	12.6	12.6	12.6	14.0	15.0	15.0	15.0	15.0	17.4	15.0	15.0	15.0	15.0	18.3	22.01	
Strengthen existing pasture/forage seed quality control laboratories by enhancing quality checks and ensuring proper distribution	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	15.0	Public/ Government
Strengthen 13 fodder demonstration farms and 8 fodder seed production farms in the coming five years and make them up to 90% operational (staffing, machinery, infrastructure, irrigation, fences, etc.)	3.0	3.0	3.0	3.0	3.0											15.0	Government
Encourage private investment in fodder production such as alfalfa and hybrid napier grass for sourcing by the dairy industry. Offer government support in the form of land provision	2.0	2.0	2.0	2.0	2.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	60.0	Private
Develop private fodder seed production farms that supply quality fodder seeds (28, 57 and 66 ha fodder seed production land in the first, second and third five years, respectively)					1.4					2.35					3.3	7.1	PPP: Government 25% subsidy
Provide feed block machines to improve utilization of crop residues and conversion to feed blocks. 20 machines per livestock production zone. Each machine costs INR 8 lakh	4.8	4.8	4.8	4.8	4.8	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	7.2	96.0	Under Mission shakti. WSHG (Public)
Promote silage-making program in hilly and mountain and northwest livestock production zones for use in coastal plain zone under disaster management program. For 10 tonne production/year total maize cost is INR 61,000. Government offer 90% subsidy. Establish storage silos	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	1.81	27.1	Public

Investment intervention	Investment cost (crore INR)																Budget source
	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	Total	
Total breeding investments	7.0	30.0	15.0	10.0	20.0	0.0	10.0	375.0	10.0	0.0	5.0	0.0	5.0	0.0	0.0	487.0	
Increase the capacity of the existing semen bank to 20 lakh straws/year in the coming 5 years (only the purchase of bulls and land for feed production is required) and add an additional semen bank with a capacity of about 15 lakh straws/year between 2025–26 and 2030–31 and a further 15 lakh straws/year capacity semen bank between 2030–31 and 2035–36	2.0				5.0			375.0								382.0	Government/ central scheme
By 2025–26, all 8 existing breeding farms will be functional and upgraded. High-grade animals should be included in the farms. One farm to be used for embryo transfer, sexed semen and molecular genetic purposes	5.0		5.0		5.0		10.0		10.0		5.0		5.0			45.0	Public
Upgrade the existing facility at Cuttack to a liquid nitrogen production plant in 2023 and create 3 liquid nitrogen storage plants in the coming 5 years, 1 per zone		30.0	10.0	10.0	10.0											60.0	Public
Total animal health investments	174.8	148.5	133.5	108.5	112.9	120.5	105.5	100.5	105.5	100.5	101.0	106.0	101.0	101.0	106.0	1,725.7	
Increase the number of veterinary dispensaries from the current 541 to 650 by 2026–27, 750 by 2031–32 and 850 by 2036–37. Each veterinary dispensary costs INR 2 crore to establish, rising to INR 2.5 crore over the 15-year period taking inflation into consideration	58.0	40.0	40.0	40.0	40.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	50.0	718.0	Public

Investment intervention	Investment cost (crore INR)																Budget source
	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	Total	
Increase the number of mobile veterinary service providers from the current 314 to 450 by 2025–26. Subsequently add 30 mobile clinics per year for 10 years	10.8	7.5	7.5	7.5	7.5	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	9.0	130.8	Public
Increase the number of aid centres/ Goshalas in Odisha to 3,239 by 2025–26, 4,000 by 2030–31 and 5,000 by 2035–36. This includes the scheme under Sarakari Yojana to address stray animals	60.0	60.0	60.0	60.0	64.4	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	40.0	704.4	Public
Improve the capacity of Odisha Biological Products Institute and its satellite by strengthening, re-equipping and modernizing with necessary infrastructure	5.0		5.0				5.0		5.0			5.0			5.0	30.0	Public
Under the Odisha industrial policy promote three veterinary pharmaceutical manufacturing facilities to meet the needs of the state. Companies may be incentivized (e.g. in the form of subsidies on land and a common effluent treatment system) to develop a vet pharma and biological park where the necessary vaccines can be manufactured	40.0	40.0	20.0			20.0										120.0	Private
Improve the capacity of the 30 diagnostic laboratories in Odisha	1.0	1.0	1.0	1.0	1.0	1.5	1.5	1.5	1.5	1.5	2.0	2.0	2.0	2.0	2.0	22.5	Public
Total research and extension investments	211.0	161.7	112.4	63.3	64.1	35.0	16.0	17.1	18.2	19.4	20.7	22.0	23.5	25.1	26.8	836.29	

Investment intervention	Investment cost (crore INR)																Budget source
	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	Total	
Establish three regional livestock research centres (one every five years). Cost of establishment would be about INR 10 per centre crore. Recruit 300 Veterinary Assistant Surgeon (VAS) and Pashu Sahayaks. Factor in an operational budget of about INR 10 crore per year	10.0	10.7	11.4	12.3	13.1	14.0	15.0	16.1	17.2	18.4	19.7	21.0	22.5	24.1	25.8	251.3	Public
Establish one Dairy Science College under the proposed Fisheries and Veterinary sciences university to serve as a dairy excellence centre offering undergraduate and diploma programs as well as farmer training		50.0				20.0										70.0	Public
Strengthen the telecommunication extension service. Introduce ICT for mobile clinics and AI intervention using SMS/WhatsApp	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	15.0	Public
Establish an Fisheries and Veterinary sciences university in the state of Odisha (as per the proposal already in action) and encourage investment in a private sector veterinary college (Siksha Anusandhan)	200.0	100.0	100.0	50.0	50.0											500.0	INR 300 crore public and INR 200 crore private
Total marketing and processing investments	344.0	350.0	355.6	360.6	365.9	315.9	436.2	316.2	317.6	316.5	568.0	318.0	318.0	318.0	318.0	5,318.5	
Add one more powder plant to produce dairy whitener and condensed milk in the first 5 years and a second one in 2032–37							120.0				250.0					370.0	Private

Investment intervention	Investment cost (crore INR)																Budget source
	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	Total	
Introduce a mid-day meal scheme for children and pregnant women as well as nursing mothers. Each individual to receive 100 ml milk per day for 200 days (a total of 20 litres of milk per person), with the number of beneficiaries to be 50 lakh	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	300.0	3.00.0	300.0	300.0	300.0	300.0	4,500.0	Central DCWW (Central Department of Child and Women Welfare)
Promote local products by incentivizing the HORECA segment in the first five years	10.0	10.0	10.0	10.0	10.0											50.0	Public
Introduce a quality enhancement program for the industry, including 5,000 automatic analyzers at OMFED bulk milk centres and chilling centres	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	150.0	Public
Improve the milk collection system by incentivizing farmers in the hilly and mountain zone and putting the unused assets of Bulk milk Cooling units (BMCUs) back on track in the first five years from 2022. In addition, 150 WSHGs will be encouraged to move into small-scale/cottage units to produce local products under an entrepreneurship development program	20.0	25.0	30.0	35.0	40.0											150.0	Public
Introduce system for collection of raw milk from producers and bulkers. About 140 bulk milk collection centres will be established in the first 5 years, 160 in the second 5 years and 200 in the final 5 years	2.0	3.0	3.6	3.6	3.9	3.9	4.2	4.2	5.6	4.5	6.0	6.0	6.0	6.0	6.0	68.5	Private

Investment intervention	Investment cost (crore INR)																Budget source
	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	Total	
Create 100 modern retail trade points per year over the next 15 years for the promotion of milk products by the industry	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	30.0	Public
	749.4	702.8	629.2	555.0	576.9	486.4	582.7	823.8	466.3	453.7	709.7	461.1	462.5	459.1	469.1	8,587.6	Public

Table 52: Investment budgets for 15-year red meat improvement intervention

Investment intervention	Investment cost (crore INR)																Budget source
	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	Total	
Total feed investments	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	3.0	
All feed improvement investments indicated in the dairy improvement will also cater to sheep and goats (see Table 51)																0.0	Government
Improve the productivity of land under permanent pasture/grazing, cultivable wasteland and barren land (about 17 lakh ha in 2020–21) by over-sowing with improved grass and leguminous forage seeds and use of fertilizer where applicable. Increase rehabilitated permanent pasture/grazing land to 50% of the total permanent pasture land by 2025–26, 70% by 2030–31 and 80% by 2036–37. Explore the option of forest grazing and planting forage trees. Estimated cost INR 20 lakh per year	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	3.0	Government
Total breeding Investments	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	5.5	82.5	
Strengthen the existing 6 goat and 1 sheep breeding farms to improve their capacity to develop and multiply improved local goat and sheep breeds. The investment needed would be about INR 10 crore every 5 years	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	2.0	30.0	Government
Promote the establishment of 5 private breeding farms per year to generate improved goats and sheep. Incentivize the number of kids distributed. The cost of setting up a proper breeding farm with housing and medical facilities would be INR 50 lakh per farm (INR 37.5 crore in total). Establishment costs to be borne by private investors. Budget of INR 1 crore per year as subsidy. Self Help Group (SHG) option may be explored.	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	3.5	52.5	Private. State support only by way of land and investment subsidy (45.0 public and 7.5 private)

Investment intervention	Investment cost (crore INR)																Budget source
	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	Total	
Total animal health investments	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
The veterinary hospitals/polyclinics, veterinary dispensaries and veterinary aid centres interventions presented in the dairy improvement investment options section will cater to all species, including goats and sheep (see Table 51)																0.0	Government
Total research and extension investments	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	7.5	
Research improvement interventions presented in the dairy intervention section will cater for all other species, including goats and sheep (see Table 51)																0.0	Government
All training centre interventions presented in the dairy intervention section will cater for all other species, including goats and sheep (see Table 51)																0.0	Government
Provide 100 Pashu Saki and Prani Mitra training sessions every year	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	0.5	7.5	Government
Total marketing and processing investments	59.2	40.2	27.4	39.9	22.7	57.7	30.2	38.2	31.2	33.2	28.7	43.7	28.7	39.2	24.2	544.4	
Establish 360 livestock markets (120 every five years) in mandis: 314 at the block level and 56 in other areas where the mandi markets flourish. Each mandi/market to have spaces allocated for live animal/bird trade and a small slaughterhouse where consumers can purchase directly from the farmers and have the animals processed. The additional infrastructure would cost about INR 1 crore per mandi/market space	25.0	25.0	25.0	25.0	20.0	25.0	25.0	25.0	25.0	20.0	25.0	25.0	25.0	25.0	20.0	360.0	50:50 basis from Government and private sector

Investment intervention	Investment cost (crore INR)																Budget source
	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	Total	
Establish 5 small-scale (20–30 animals/day) goat and sheep slaughterhouses per year (75 in total) initially within municipalities and urban bodies. Ultimately, all district headquarters will have certified slaughterhouses	1.0	1.0	1.2	1.2	1.5	1.5	1.5	2.0	2.0	2.0	2.5	2.5	2.5	3.0	3.0	28.4	Private. State support only by way of land and investment subsidy
Establish 8 model scientific goat and sheep abattoirs: 3 will be established by 2025–26 in Bhubneshwar, Cuttack and Rourkela. A further 3 will be established by 2030–31 and 2 more by 2035–36 mainly to meet the needs of the new e-commerce model of meat delivery. The cost per abattoir would be INR 10 crore and each will have a capacity to slaughter more than 200 animals/day	10.0	10.0		10.0		10.0		10.0		10.0		10.0		10.0		80.0	Private. State support only by way of land and investment subsidy
Establish 1 incubation centre for the start-up of animal protein market under the proposed Fisheries and Veterinary sciences university		3.0														3.0	Government
Establish 2 goat and sheep meat processing plants Export Oriented Unit (EOU), 1 in the first 5 years and 1 in the second five years. Use the experience of the Falcon model	20.0					20.0										40.0	Private. State support only by way of land and investment subsidy
Develop 100 new retail outlets per year for selling meat/animal protein. The budget to start a modern meat outlet would be INR 1 lakh per outlet, with a subsidy component of INR 20,000 and an investment from the self-employed youth of INR 80,000. Total annual subsidy component is INR 20 lakh	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	15.0	INR 3 crore State support subsidy plus INR 12 crore from self-employed youth
Promote the local breed by designating it as superior meat for export as being done by Bakri (Himalayan goat) in Uttarakhand. Budgeted at INR 20 lakh per year	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	3.0	Government

Investment intervention	Investment cost (crore INR)																Budget source
	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	Total	
Establish 5 tanneries for handling sheep/goat hides and skins: 2 tanneries will be established by 2025–26, 2 by 2030–31 and 1 by 2035–36. Each tannery will have the capacity to treat 5,000 hides. A collection system will be created. To prevent loss of raw material butchers will be trained to clean hides and treat them with salt/turmeric as well as to prevent them getting damp	2.0			2.5			2.5		3.0			5.0				15.0	Private. State support only by way of land and investment subsidy
Grand total	65.4	46.4	33.6	46.1	28.9	63.9	36.4	44.4	37.4	39.4	34.9	49.9	34.9	45.4	30.4	637.4	

Table 53: Investment budgets for 15-year poultry production improvement intervention

Investment intervention	Investment cost (crore INR)																Budget source
	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	Total	
Total feed investments	12.2	14.5	19.0	19.0	4.0	21.9	23.0	24.0	23.0	25.0	25.6	27.0	37.0	31.0	32.0	338.2	
Strengthen the existing feed quality control laboratory within the OUAT animal nutrition laboratory in 2021–22. Establish 1 new laboratory per production zone by public 3 and 3 by the private sector in the first 5 years and establish 10 new laboratories by the private sector as part of the feed processing plant in the second 5 years. The cost of enhancing the current laboratory infrastructure is approximately INR 2 crore, and the cost of establishing a new laboratory is INR 3 crore	2.0	6.0	6.0	6.0		6.0	6.0	6.0	6.0	3.0						47.0	Public/private (11.0 crore INR public and 36.0 crore INR private)
Make insect traps with light sources available for purchase by farmers at a subsidized rate. In total, 1,00,000 are planned, with 50,000 in the first 5 years and the remainder over the next 10 years. The cost of insect traps varies from INR 1,000 to INR 5,000. 50% subsidy may be given by the State Government	4.0	2.0	2.0	1.0	1.0	2.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0	1.0		20.0	Public/private (50/50)
Increase area of land allocated for maize and soybean production by 1,86,000 ha by 2025–26, 3,42,000 ha by 2030–31 and 5,86,000 ha by 2035–36	1.2	1.5	2.0	3.0	3.0	4.9	6.0	8.0	11.0	12.0	14.6	16.0	18.0	20.0	22.0	143.2	Public (only the subsidy component s considered)

Investment intervention	Investment cost (crore INR)																Budget source
	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	Total	
The total indicative chicken feed demand is estimated to reach about 5.9 MT lakh by 2025–26, about 9.1 MT lakh by 2030–31 and 14.2 MT lakh by 2035–36. To meet this demand, 4 additional commercial feed processing plants will be needed by 2025–26, with 6 more by 2030–31, and 6 more by 2035–36. The capacity of plants will vary from 100 to 300 (tonn per day) (TPD). The cost would be about INR 5 crore for a 100 TPD plant and about INR 9 crore for a 300 TPD plant	5.0	5.0	9.0	9.0		9.0	10.0	9.0	5.0	9.0	10.0	10.0	18.0	10.0	10.0	128.0	Private
Total breeding investments	2.3	4.2	4.3	4.2	0.2	2.2	2.2	2.1	4.2	2.2	2.1	2.2	2.1	2.1	2.0	38.6	
Establish 20 additional DOC production farms: 4 for improving the local backyard chicken and 16 for commercial poultry. The cost would be about INR 1 crore for a small farm and INR 2 crore for a medium-sized farm	2.0	4.0	4.0	4.0		2.0	2.0	2.0	4.0	2.0	2.0	2.0	2.0	2.0	2.0	36.0	Private/public (4.0 crore INR public, 32.0 crore INR private)
Reduce reproductive wastage through the introduction of brooding and artificial incubation facilities such as hay box brooders for backyard chickens. Total of 20,000 brooder boxes with a small heater coil, each costing about INR 1,000	0.2	0.2	0.2	0.2	0.1	0.2	0.1	0.1	0.1	0.2	0.1	0.1	0.1	0.1		2.0	WSHGs supported by Government
Promote small-scale incubators in the hilly and mountain zone. Total of 300 incubators, each costing INR 20,000	0.1		0.1		0.1		0.1		0.1			0.1				0.6	WSHGs supported by Government
Total research and extension investments	0.5	20.5	0.5	0.5	0.5	0.5	0.5	0.2	0.4	0.4	0.2	0.4	0.4	0.4	0.4	26.6	
Establish 1 research centre to serve as a poultry excellence centre under the proposed Fisheries and Veterinary sciences university		20.0														20.0	Government

Investment intervention	Investment cost (crore INR)																Budget source
	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	Total	
Increase the efficiency of public and private veterinary services by creating 100 veterinary clinics with pharmacies to promote self-employment of veterinary graduates. The cost of setting up a clinic would be about INR 3,00,000; a subsidy of INR 1,00,000 may be given to promote such clinics	0.3	0.3	0.3	0.3	0.3	0.3	0.3		0.15	0.15		0.15	0.15	0.15	0.15	3.0	Private. Subsidy of 1/3 cost to be borne by Government, 2/3 of cost from private investment
Conduct 12 poultry farmer workshops per year. Each workshop to cost about INR 2 lakh	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	0.24	3.6	Government
Total marketing and processing investments	49.3	44.3	49.3	44.3	44.3	49.3	44.3	44.3	49.3	44.3	44.3	49.3	44.3	44.3	44.3	689.5	
Promote hygienic chicken slaughter facilities by incentivizing at all meat marts and registering facilities under FSSAI. To hold a competition and cost of INR 1,000 per store per quarter..Fines to be collected for non-compliance. Aim to cover 30,000 outlets over the next 15 years (2,000 outlets per year)	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	0.8	12.0	Government
Develop 2,000 new outlets per year. Cost of setting up is INR 50,000	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	10.0	1,50.0	Private
Establish modern chicken cutting and processing plants to increase chicken meat production. 5 new plants in total: 1 for organic chicken and 4 for regular processed chicken	5.0		5.0			5.0			5.0			5.0				25.0	Private
Include eggs for better nutrition for women and children in the mid-day meal program. 4 crore eggs per year through Department of Child and Women Welfare. INR 4 per egg	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	16.0	240.0	Public

Investment intervention	Investment cost (crore INR)																Budget source
	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035	2036	Total	
Develop social marketing and online delivery platforms to promote chicken and egg consumption. Annual budget INR 5 crore	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	75.0	Private
Engage private integrators to work on providing DOC and helping farmers with the necessary inputs. Currently 5 integrators are working in the state. Each integrator to work with 125 farms every five years and to add 5 additional farms per year. Each farm working for an integrator needs to contribute about INR 50 lakh for infrastructure	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	12.5	187.5	Private
Total Investment	64.3	83.5	73.1	68.0	49.0	73.9	70.0	70.6	76.9	71.9	72.2	78.9	83.8	77.8	78.7	1,092.9	

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